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THE

JOURNAL OF SCIENCE.

APRIL, 1884.

I. HYBRIDISM WITH REFERENCE TO THE THEORY OF EVOLUTION.

By J. W. SLATER.

THE rarity, or rather, in the opinion of some persons, the absolute non-existence of true hybrids capable of reproduction, is sometimes yet brought forward as a fact hostile to the doctrine of Development. Even avowed Evolutionists occasionally make such statements as the following, which we have recently met with in a book of much merit:—"The objection drawn from the physiological difference between species and races still exists unrefuted," and is indeed "the great stumbling-block to all theories of Evolution."

It will therefore not be an idle undertaking to re-examine the facts bearing on this question, and see whether they necessitate or admit of the interpretation so often put upon them.

Briefly recapitulating the views of the Old School we find it asserting that whilst orders, families, and genera are mere man-made groups, having no actual existence, species possess, on the contrary, a distinct objective character. Each such species consists of animals—or plants—which are, or might have been, descended from one original couple, and it is distinguished from every other species *morphologically* and *physiologically*. The morphological characteristic was a structural resemblance between the individuals of one and the same species, coupled with a structural dissimilarity

from individuals of any other species. This combined likeness and unlikeness was, however, and is still, very difficult to estimate, whence in many cases there arose great difference of opinion as to the number of species of some particular group inhabiting any given country. This very fact, by the way, contributed no little to undermine, in the minds of careful inquirers, the notion of the absolute distinctness of species. To supplement the morphological boundary between species and species the so-called "physiological test" was appealed to. If two individuals of opposite sexes were seen *in copula*, this observation was taken for proof positive that they belonged to the same species. In like manner it was held that a brood of young animals must belong to the same species as their mother, or as both their parents if discoverable.

It must be admitted, however, that for multitudes, especially of the smaller animals, this so-called "physiological test" has not the slightest value. In how many, or rather how few, cases can we trace the entire series from the copulation of the parent animals to the appearance of the young!

Another point in the creed of the Old School was the broad, absolute distinction between "species," "variety," and "race." Species was a something primordial and absolute; race, a something formed by change of climate, diet, or other surroundings. Races might pass into each other; species, however structurally similar, never. Fruitful intercourse was possible between individuals of different races, but not between those of different species.

I shall not, I think, be open to the charge of misrepresenting the views of the Cuvierians on the question of hybridism if I put forward the following propositions, which are all, explicitly or implicitly, contained in their writings, and which are, indeed, the logical outcome of the doctrine of the Immutability of Species:—

I. Without human interference sexual intercourse never takes place between individuals of different species.

II. If by dint of such interference connection does happen, it is normally unfruitful.

III. In the exceptional cases where a hybrid is produced it is barren or impotent, and incapable of reproduction.

All these propositions can, I think, be successfully controverted.

As regards the first assertion it is, of course, refuted by all the very numerous instances where hybrids have been produced without any human aid or contrivance. But there are, further, cases almost innumerable of intercourse between animals of widely different species where no offspring has been known to result. Thus there is on record ("American Naturalist," xvii., 359) the long-continued intimacy of a male elk with a Durham heifer. A stag has been known to pair with cows in Scotland. The present writer once saw, in Austrian Silesia, a hound copulating with an ewe, and was told that this was a very common action on the part of the dog. A Newfoundland dog has been known to have intercourse with a sow. Without needlessly multiplying further examples I may lay down, as a counter-proposition based upon facts, that—

> "Male animals, without human interference, will, in default of a mate of their own species, pair with any female not too dissimilar from themselves in size, structure, and habits."

Let us turn to the second proposition. The number of hybrid forms which have been produced is so great that their birth cannot be regarded as an abnormal result. Macgillivray, as quoted by Darwin in the "Descent of Man," gives an instance of a male blackbird which paired with a female thrush, and produced a family of young birds. The great wood-grouse (*Tetrao urogallus*) very commonly espouses the black hen (*T. tetrix*), and the hybrids sprung from this alliance have been recognised as a distinct species under the name of *Tetrao medius*, and in some districts are, according to Semper, superseding the pure strain of black game; whence it may be fairly concluded that *T. medius* is not incapable of reproduction. In the gardens of the Paris "Society of Acclimatisation" there are, or were in 1882, two male hybrids, one between a Houdan cock and a Guinea hen, and the other between a Cochin China cock and a turkey hen. According to Darwin (*opus citat.*, p. 414) eighteen cases have been recorded, in Great Britain alone, of hybrids between the black grouse and the pheasant. A wild duck has been known to nest with a male pintail, and rear a brood of seven or eight hybrid ducklings. According to Rev. W. D. Fox (*ibidem*) "a pair of Chinese geese (*Anser cygnoides*) were placed on the same pond with a common gander and three geese. The result was that of the young birds hatched from the eggs of the common geese only four were pure, the other eighteen proving hybrids."

The Rev. E. S. Dixon, quoted in the same work, remarks that "those who have kept many different species of geese together well know what unaccountable attachments they are frequently forming, and that they are quite as likely to pair and rear young with individuals of a species apparently the most alien to themselves, as with their own stock."

Waterton ("Essays," p. 400) mentions that a female Canada goose paired with a bernacle gander, and that they produced a brood. The hybrids which have been produced between different species of song-birds are, as every bird-fancier can testify, exceedingly numerous.

In short, the second proposition of the Old School has literally not a leg to stand upon, if it claims to rank as a general truth. It can be merely tolerated in the following very modest form:—"If animals of different species copulate, some will produce viable young, and others not."

We come now to the last of the three propositions, which asserts that if the intercourse of a male and a female of different species produce young, the latter are barren.

In refutation we will take first the case of the American bison and the domestic cow. According to Mr. J. A. Allen's valuable monograph ("History of the American Bison") it is distinctly shown that the bison bull interbreeds freely with the domestic cow, and that the half-breeds are fertile. This fact is of the greater importance since the two animals belong to distinct genera.

We must not forget the case of the so-called "*leporides*," hybrids between the hare and the rabbit, the existence and the reproduction of which have been admitted in "Cosmos les Mondes," a paper assuredly free from any Evolutionist leanings. There is also no well-founded doubt that the blood of several distinct species of Canidæ has been mingled to form the domestic dog. The Japanese lap-dog (*Drysodus pravus*), though differing generically from the common dog, interbreeds with it freely.

We come now to birds. That the hybrid between *Tetrao urogallus* and *T. tetrix*, above mentioned, is capable of reproduction seems to be a necessary inference from its multiplication. But as I am not aware that any observer has actually seen a nest where one of these hybrids was either father or mother, I will not insist on this case. A far more important instance is that recorded by Mr. Seebohm in his "Siberia in Asia," and it is the more completely satisfactory because every possibility of human interference is absent. The carrion crow and the hoodie mate freely together. According to Mr. Seebohm, in the district of Yeniseisk

75 per cent of the crows are thorough-bred carrions, perhaps 5 per cent pure hoodies, and the remaining 20 per cent are hybrids of every stage between the two. He found pairs of such hybrid birds mated together, and producing eggs and young. This instance is the more valuable because it meets the cavil that though a hybrid may fecundate, or be fecundated by, an animal of the original pure strain, yet two hybrids cannot prove prolific together.

It is on account of this cavil that I lay little weight upon the instance of the she-mule now in the gardens of the Society of Acclimatisation, of Paris. This animal has brought forth six foals, by zebras, by an ass, and by a stallion.

The third proposition is therefore fully refuted. If there were between distinct species some absolute, primordial, Divinely-ordained boundary to prevent the intermixture of species, we might surely expect that in every case copulation between animals of such different species would be absolutely null and void. In other words, in such a case the male element would produce no more effect upon the germ-cell than would the contact of a drop of water, or of blood, or of milk. But in place of this absolute action or nullity we find a series of effects ranging from nullity upwards. In some cases there is doubtless no action at all. In others the germ-cell exhibits segmentation more or less normal, which, however, becomes prematurely arrested. In a third set of cases there is a production of living young, and in a fourth these young are themselves capable of reproduction. These facts are totally irreconcilable with the theory of an absolute boundary. In part they are already explained by very simple mechanical considerations (*see* Dr. Pflüger's researches on the Hybridisation of Amphibians, "Journal of Science," 1884, p. 30). Thus in some cases the spermatozoids, from their size and shape, are prevented from entering the ovum owing to the narrowness of the micropyle. All this, I repeat, is quite out of harmony with the teachings of the Old School.

There is another consideration not to be overlooked: when a negative dogma is to be met by positive instances, and we find a notable amount of such instances after surveying only a very small portion of the field, we may not unfairly argue that on further inquiry these instances will be multiplied. On the other hand, they cannot be diminished. Hence we have everything to hope and nothing to fear from further research. We see, *e.g.*, among birds, how many instances of the production of hybrids have occurred among those

three groups which have come most extensively and closely under human observation,—to wit, the poultry tribe, the geese and ducks, and the finches and thrushes. It is surely therefore reasonable to expect that if other families of birds were submitted to similar investigation, the number of affirmative instances would be increased. I may safely say that not one species in a thousand has been examined so closely that we can say with anything like confidence whether it is capable of reproduction with some allied species or not. If we observe animals in a state of nature we may, perhaps, not find a crucial instance once in a quarter of a century. If we experiment upon them in captivity we are met by the difficulty that many animals do not breed freely in confinement, even when mated with one of their own species. Differences of temperature, of diet, of exercise, of exposure to light, and a variety of other circumstances not capable of affecting the health of an adult animal, may yet prevent it from breeding, or may prove destructive to its young. For anything we can show to the contrary many existing species may have had their origin in hybridisation.

Let us now discuss some of the arguments used to explain away, if possible, the facts which have been brought forward. We hear it sometimes said that if two animals are capable of engendering together they must belong to the same species. If this assertion is valid, then the horse, ass, and zebra are merely different races of one and the same species. So, too, are respectively the American bison and the common cow; the dog, wolf, and fox; the lion and the tiger; the hare and the rabbit; the hoodie and the carrion crow; the blackbird and the thrush; and multitudes of other species differing from each other in form and in habits. In short, to preserve a dogma, for it is nothing more, the classification of the animal—and in like manner of the vegetable—world is to be thrown in heaps. This plea is, in short, an excellent instance of the working of the principle *tant pis pour les faits!* But we may take another step. Suppose that the copulation of two animal forms, ordinarily held to be distinct, leads, not indeed to the birth of living young, but to the earliest stage of conception, or, in technical language, to the segmentation of the ovum, what are we then to conclude? Do the two animals belong to one and the same species? If they do, they ought to be capable of producing viable young. If they do not, then, according to the creed of the past, their intercourse should be utterly null and void.

Again, we may take the case of the mule, ordinarily infertile. If its parents belong to one and the same species they ought to reproduce not merely a living, but a fertile offspring, If our opponents seek to get over this difficulty by pleading that the horse and the ass, though of the same species, belong to different races, they make the admission —ruinous to them—that there is no absolute difference between race or variety and species, the former being at least a stepping-stone to the latter. "Ruinous," I would say, because it in effect involves the abandonment of their vaunted physiological characteristic of species as distinct from varieties.

The second plea of the Cuvierians—if they will permit me to call them so—is not more valid than the first. Looking over the long list of cases above given, they say—"But these are mere exceptions, and there is no rule without exceptions!" I am half inclined to suspect that this very notion of exceptions to all rules is a proof of the radically unscientific character of the minds which entertain it. I find in an important paper in the "Deutsche Rundschau," by Professor Preyer, of Jena, the following very significant remarks:—"The philologian only will refuse to admit that grammar, *with its endless exceptions*, is a heavy load for the memory rather than a discipline for the logical faculty. The student thus, almost involuntarily and unconsciously, learns to *admit exceptions in the case of other rules, such as the laws of Nature.*" Now in the rules or laws of Nature, when founded on a proper induction and clearly understood, there are no exceptions. If you can give us one instance of the destruction or the creation of matter, the so-called law of the permanence of matter falls at once to the ground, or is seen to be no law. If by any manipulation of ours we can, in any one case, create energy, the law of the conservation of energy must be forthwith given up. If one only of the elementary bodies of chemistry is found capable of combining with other bodies in fluctuating proportions, the atomic theory goes to the winds; and, just in the same manner, if we have one single instance of fruitful intercourse between animals of different species, the assumed law that such an event is impossible, and with it the physiological test of species, is annihilated, or rather is found never to have had a rightful existence.

But the notion of "no rule without exceptions," idle as we have seen it to be, is capable of assuming a more malignant phase. We sometimes hear it said that "the exception proves the rule." This floscule is most common

in the mouths of historians, grammarians, and the like. Sorely perplexed would these worthies be if called upon to show, in the case of any law of Nature such as those we have mentioned above, how an exception could "prove the rule." Indeed the persons who apply this phrase to natural questions prove two things,—their inborn or inbred inaptitude for Science, and their ignorance of their own craft. For the origin of the saying may be illustrated by the following examples:—If we find that in some country or at some age an especial legislative act or royal charter was necessary, *e.g.*, to enable some man to obtain a divorce, we may then conclude that in the rule, in the common course of law, divorces were not granted; and here therefore, and in a host of parallel matters, it is rational to say "the exception proves the rule." But it will be at once seen that there is here no possible remotest analogy with anything in the laws or rules which we discover in Nature.

Looking over the facts brought forward and the considerations advanced I certainly fail to see how the absolute infecundity of animals of different species and the so-called "physiological test" can justify themselves to any candid inquirer.

II. DAILY VARIATIONS OF THE STRENGTH OF THE WIND ON LAND AND AT SEA.

THE researches of Herr W. Köppen on this subject have been recently laid before the public in the "Naturforscher."

Though the daily periods of temperature and of barometric pressure, as well as a number of other meteorological elements, have been for many years the subject of close examination, it is only of late that the daily period of the strength of the wind has been taken into consideration. Yet this very feature shows itself more distinctly and generally than any other meteorological element, with the sole exception of the temperature, and perhaps of relative moisture. As will appear below, the daily period of the strength of the wind is perhaps even of greater significance

than that of the variables just named. The most striking characteristic of this periodicity is the intensification of the wind in the hottest time of the day,—a feature which, according to Hann, is recognised in all continental stations, whatever may be their climate or the prevailing character of their winds.

This daily maximum of the strength occurs in Upsala, Cracow, Hamburg, and Dresden, at 1 p.m.; at Vienna, Birmingham, Liverpool, Toronto, Calcutta, and Ascension, at 1.30 p.m.; at Prague, Oxford, Batavia, and Melbourne, 2 p.m.; Petersburg, Halifax, Mauritius, 2.30; Bern, 3; and Rome, 3.30 p.m. At these places the entire daily variation in the strength of the wind takes place while the sun is above the horizon. During the night the wind is equally low, and even in the first hours after sunrise it varies little from the nocturnal value. The wind arises, especially on clear days, some hours after daybreak, and subsides again at night. In the intermediate time it increases towards noon; and in plains, in the interior of tropical and subtropical continents, it reaches daily almost the intensity of a storm. This is especially the case in the region of the trade-winds and in the dry season.

In the open sea, as has been recently shown by Mr. Buchan from the observations made on board the *Challenger*, the case is quite different. In the middle of the ocean there is scarcely any appreciable daily variation in the strength of the wind. It retains during the night the same relatively high figure which appears by day. According to two concordant observations, however, the trade-wind shows a slight periodicity, the maximum being at 8 a.m. and the minimum at 4 p.m.

The increase of the speed of the wind in the warmer hours of the day, observed as a universal fact on land, is confined, however, to strata of air which are for considerable distances in direct contact with the earth's surface. In the free, upper regions of the air, the wind is not stronger at noon than at morning and evening, but weaker. This fact was first demonstrated by Hellmann on Mount Washington and on the Righi. Köppen gives several other instances of a similar nature.

As far back as 1840 Espy gave a satisfactory explanation for the main features of the daily periodicity of the wind:—"The beginning of the formation of ascending columns of air in the morning will be accompanied by an increase in the strength of the wind, and its strength will grow with the increase of these columns, both phenomena keeping step

with the rising temperature. This acceleration of the wind is in part determined by the influx of air on the earth's surface from all sides towards the centre of the rising columns, which thus produces inconstant breezes; in part also by the descent of air in the regions surrounding the ascending columns. Such descending air retains the velocity which it possessed in the upper regions, and which is well known to be greater than that of air in immediate contact with the earth's surface."

Without any knowledge of Espy's explanation, Köppen, as far back as 1879, whilst discussing Hann's observations, propounded the hypothesis that the daily periodicity of the wind depends on two conditions—1st, the varying intensity of the perpendicular exchange of air in the lowest 1000 to 4000 metres of the atmosphere, with a motion which on the average increases from below upwards, on account of diminishing friction; 2nd, the preference of the warmer hours of the day, in consequence of the appearance of steep gradients by difference of pressure at small distances. This explanation is practically at one with that of Espy,—a fact so much the more interesting as the latter *savant* had at his command in 1840 but a scanty array of facts for his inferences, whilst now a formidable series of arguments can be produced in favour of this hypothesis.

The latter of the two causes mentioned consists in the especial occurrence of thunderstorms, with their accompanying depressions, local whirlwinds, &c. The nature and the local movement of the gradients may be seen strikingly illustrated in Köppen's memoir on the thunderstorm of August 9th, 1881. As these gradients may have very different directions, and may be propagated very differently, all the winds may undergo in the course of time such temporary accelerations which, by their occurrence in the hottest part of the day, contribute essentially to the known form of the wind on land.

But this cause accounts for merely a subordinate portion of the phenomena of the daily period of the strength of the wind. This is shown by the fact that the mid-daily acceleration of the wind is often very distinctly characterised in cases where the foregoing explanation is manifestly inadmissible. This is especially the case in great aërial currents which retain an approximately constant direction. As examples we may take the trade-wind in the dry season in the interior of Africa and South America, and the persistent east winds accompanied by dry clear weather in the temperate zone.

The efficacy of the other cause, which we must consequently acknowledge as the main cause of the entire phenomenon, is easily seen. The velocity of the movement of the air augments, generally speaking, from the earth's surface to a great altitude, on account of the decrease of friction. When, therefore, masses of air arrive from the heights at the surface of the earth they bring with them, generally speaking, a greater horizontal velocity than the masses of air under the same gradient which have been in prolonged contact with the earth's surface.

Since cold air, at the same external pressure, is denser—or, in other words, heavier—than warm air, there follows, when the magnitude of the decrease of temperature exceeds a certain value, an unstable equilibrium. A mass of air which has begun to sink becomes denser than its surroundings, and thus is impelled to sink lower, and, inversely, a mass of air which rises is inclined to further ascent. The vertical decrease of temperature which corresponds to this unstable equilibrium is 1° C. per 100 metres for dry air, and between ½° and 1° C. for moist air. If this value is reached everywhere, or partially over a large surface, there occurs a play of descending and ascending currents of air which in damp weather makes itself manifest by cumuli piled up like mountains with blue interstices. The clouds represent masses of air which are ascending, in consequence of the decrease of pressure on being refrigerated. Hence a part of their moisture is separated out in the shape of the minutest drops, forming clouds. The clear, cloudless intervals are formed by descending masses of air which are experiencing the opposite process, of increasing temperature and heat, and are consequently removing further from their point of saturation.

The mean value of the decrease of temperature upwards is greatest in the warmest hours of the day. In the night the difference of temperature between above and below becomes insignificant. In clear nights there is even, up to a certain altitude, a regular inversion of the difference, the temperature at the earth's surface being lower than it is above. This involves a very stable equilibrium of the air and a very trifling vertical circulation. In calm days, with bright sunshine, therefore especially in summer, the previously mentioned unstable equilibrium sets in a few hours after sunrise, and ceases a short time before sunset. The daily period of the velocity of the wind has the greatest correspondence with the formation of cumuli; but the connection of the two phenomena is far from complete, since

the formation of cumuli demands a certain degree of atmospheric moisture, and depends also on perpendicular currents which do not necessarily extend down to the lowest stratum of the air.

The correctness of these views is demonstrated by the fact that a series of conclusions which necessarily follow are unmistakably confirmed by observation. These are accordingly here enumerated :—

1. Wherever the daily variation of temperature and the retardation by friction are both very trifling, the mid-daily intensification of the wind—or, more strictly, the nightly lull of the wind—is wanting, even at the surface of the earth. This occurs on the open sea. The very slight friction at the surface of the water determines a very slight increase of the wind on ascending. Again, the perpendicular currents are substantially not connected with a daily period, as the daily fluctuation of temperature, even in the lowest stratum, does not exceed 0·7° C.

2. Where the intensified perpendicular circulation of the air in the warmest part of the day brings air from tranquil strata, there occurs an inversion of the period. The warmest hours of the day are then marked not by an increase, but by a decrease in the strength of the wind. This is the case on the summits of mountains which rise to a certain height over a varied landscape with a well-marked daily fluctuation of temperature, but which do not themselves greatly influence the surrounding atmosphere.

3. The daily period of the wind displays characteristic relations to other phenomena, especially to vapour-tension. In all districts where the circumstances are favourable to a periodical powerful development of the perpendicular circulation at the hottest time of the day, and where accordingly the mid-daily intensification of the wind is distinct, the vapour-tension, as far as is known, has its minimum in the warm hours and its twofold maximum in the morning and evening. This decrease at the time of greatest heat can be explained only by the fact that air, poorer in moisture because warmer, arrives from the upper regions to the surface of the earth. This phenomenon occurs only at the bottom of the atmosphere in valleys or on plains. On the mountain tops the vapour-tension, like the period of the wind, is inverted, the maximum occurring when the warm moist masses of air rise up from the low-lands.

4. On those sea-coasts in the region of the trades which have no regular sea-breeze, the trade-wind blowing over the land blows more strongly by day than by night, and shows

the same daily period of velocity as is found in the interior of the continents. Of this a signal proof is given by the indications of the anemometer at St. Helena and Ascension.

5. The diminution and inversion of the daily periodicity of the wind on high mountains does not depend on the absolute height of above the sea-level, but on the free exposure of the station on a summit of sufficient height above a varied region. Thus Köppen made observations on the Puy de Dome and on the Pic du Midi. On the former he observed a decrease and on the latter an increase of the wind at noon. The explanation of this apparent anomaly is that the station of the Puy de Dome is situate on an open rounded summit; that on the Pic du Midi lies 500 metres below the summit.

6. Researches on the relation of the velocity of the wind to the gradient, which have been undertaken by Mr. C Ley for England, and by Herr Sprung for the German coasts, give the accordant result that at 8 a.m. one and the same gradient is accompanied by a stronger wind in summer than in winter; stronger, also, with a north-easterly than with a south-westerly wind. But according to the researches of Hann and others the decrease of temperature upwards is on the average greatest in summer, and in time of north-easterly winds. As the magnitude of this decrease is generally parallel to the strength of the perpendicular exchange of air, it follows that for equal gradients there ensues a stronger wind when this exchange of air is brisk than when it is feeble, as the theory demands.

7. A particular importance attaches to the observation made independently by HH. Hjelström and Sprung, that cloudiness has a well-marked influence on the daily period of the wind. During east winds with a bright sky the daily variation is more distinct than during westerly winds accompanied by cloudy weather. A clear sky which permits free radiation acts in two directions: by day it increases the vertical exchange of air by augmenting the vertical decrease of temperature, and consequently it intensifies the velocity of the wind in the lower strata of the air. At night, by refrigerating those strata it produces a firm equilibrium in the vertical direction, and thus withdraws the lower air from the influence of the upper, more rapidly moving, atmospheric strata. If the gradients are the same, there is therefore a stronger wind by day and a weaker by night in clear weather than under a cloudy sky.

8. Perhaps the most interesting feature of the daily periodicity of the wind is its relation to the daily variation in

its direction. In a special memoir on this subject Herr Sprung has shown that an intensification of the wind whilst the gradients remain unchanged is, under ordinary circumstances, conceivable only if the angle of deviation is simultaneously augmented. In fact the observations made at eighteen stations in the interior of the Eastern Continent show, in the forenoon, on the average, a decided deviation of the wind in accordance with Dove's law of deflection, whilst in the afternoon deviations in the opposite direction slightly predominate. The predominance of deviations of the wind along with the course of the sun—which is determined by the position of the north temperate zone with reference to the predominating tracks of barometric minima—is increased in the forenoon, but decreased in the afternoon, by a cause acting periodically. This cause is the descent, into the lowest stratum of the atmosphere, of masses of the upper air which are moving more rapidly and at a greater angle to the gradient. On account of the increased angle of deflection the track of the clouds deviates, as is well known, to the right hand of the wind. Observations on cloud-movements reveal, in the upper strata of the atmosphere, a daily period in the direction of the wind opposite to that which obtains below, quite analogous to the inversion in the period of its velocity.

III. HALF-HOURS WITH THE OLD NATURALISTS.

[Under this title we propose giving, from time to time, sketches of the lives and researches of the earlier investigators of living Nature.]

I. JOHN SWAMMERDAM.

LET us cross not merely the German Ocean, but the last two centuries, and visit Holland in the olden time: Holland which for her size and population produced more *savants* of mark than any other country of modern Europe; Holland which amidst her eager and bustling commercialism found time and appreciation for the

profoundest studies; which did not think intellectual bondage a price necessary to be paid for political freedom; which gave to thinkers in exile an asylum and a free press; and which, in short, did such noble things that we may almost pardon her for her two deadly sins—the invention of national debts, and of chicory. Such was Holland in the seventeenth century.

The time and the place, too, were well fitted to call general attention to biological studies. The vast commerce of the Netherlands and their extended colonial empire rendered the importation of "natural curiosities" an easy and a common matter. The shells, the insects, the birds of Guiana, the Cape, and Java, were as startling and as much sought after as are now those of New Guinea or Central Africa. Hence we need not wonder if the formation of private museums became a favourite amusement among the wealthier burghers of Amsterdam. Many of these collections were doubtless mere dilettante affairs,—raree-shows, where curiosities were stored up heedless of their nature and their origin, and were admired for their beauty, their rarity, and their cost, rather than studied. But in many cases these accumulations of specimens converted both owners and visitors into naturalists of various degrees of merit.

Among these museums probably the finest and the most celebrated was that belonging to John James Swammerdam, a prosperous apothecary, or, in modern English phraseology, chemist and druggist. This worthy burgher took to wife Barentje Corver, and in time became the father of John Swammerdam, the subject of our memoir. The boy was from the earliest dawn of his understanding surrounded by zoological specimens, and from the joint influence, doubtless, of hereditary taste and early association, he became passionately devoted to the study of Natural History. When a mere boy he began to collect insects, Mollusca, &c.; but he did not—as it was the fashion before his time, and as it is still common—merely collect. We find him studying the habits and the development of these creatures, and, with such appliances as he could procure or devise, examining their inward structure. Hence we need not wonder that when his future career in life became a question for family discussion he—like in after times Darwin—felt no taste for the study of Divinity, as his father had intended.

Medicine was next suggested as being more in harmony with his tastes and studies. But it was not until he had reached his twenty-sixth year that he entered the University

of Leyden, which then enjoyed a high and well-merited reputation as one of the first medical schools of Europe. How young Swammerdam had been engaged in the meantime, save with the study of Entomology, is not recorded. Very probably the delay was in great part owing to the "delicate" health—to use an absurd modern perversion of language—which he never could shake off. At Leyden he enjoyed the instructions of Van Horne in Surgery, and of the then famous Sylvius de la Boe in Medicine. Here Swammerdam soon distinguished himself for his skill in anatomy, and especially in the preparation of anatomical specimens, in which art he opened up a new era. Here, too, he made the acquaintance of several important men, among others Steno, who was for many years his firm friend and admirer. Here, also, began his enmities and controversies, especially one with Rynier de Graaf, who claimed the merit of Swammerdam's methods of making preparations, though, as far as it can be traced, without a particle of justice. We need not be surprised if the wronged discoverer replied with some acrimony. Indeed Swammerdam's temper, like that of dyspeptics in general, was not of the sweetest; but in his many controversies we find a due discrimination between men of merit, who may have fallen into an error, and charlatans, who lay claim to the researches of others and adulterate them with their own absurdities. Witness his critique on Harvey's celebrated treatise "De Generatione," and his denunciation of Gœdart, whom he accuses of defiling the views of Harvey.

About 1665 we find him visiting several parts of France for the benefit of his health. He lived for some time at Saumur, and it is said at Lyon. Here he had the advantage of studying a fauna differing in many respects from that of Holland, and here he continued his entomological researches. In particular he studied various species of dragonflies and the Ephemeridæ. Here he began that treatise on *Ephemera Swammerdamiana*, as now named, which Prof. Westwood justly pronounces admirable. Whilst at Saumur he seems also to have discovered the valves of the lymphatics.

Thence he repaired to Paris, and in company with his friend Steno, resided for some time at the house of Thevenot, at Issy, chiefly engaged with dissecting insects. Here he was introduced to the Senator Van Bemmingen, at that time Dutch Ambassador at the French Court.

Returning to Holland he was chiefly engaged with the study of Human Anatomy and of Medicine, and became the leading spirit of a medical society founded at Amsterdam.

In 1667 he graduated at Leyden as Doctor of Medicine, after maintaining an inaugural thesis on respiration.

In the same year, however, he was attacked by a violent quartan ague, which left him permanently enfeebled. Partly in consequence of this calamity he abandoned his researches in Human Anatomy, and gave himself entirely up to Entomology.

In the following year the reigning Grand Duke of Tuscany, an enlightened prince, paid a visit to Holland. Here he went to visit the Swammerdam museum, and made the acquaintance of our hero. The Duke was so favourably impressed with what he saw and heard that he offered to purchase the collection of the younger Swammerdam—as distinct from the museum of the father—for a large sum, and to give him a permanent appointment at his Court if he would remove to Florence. Unfortunately for himself and for Science Swammerdam declined this offer, having, as he then thought, too great a love for independence. I say "unfortunately for Science," because had he accepted the Grand Duke's proposals his museum, instead of being broken up at his death and lost, would have been kept together. He would also have had full opportunity to devote the remainder of his life to researches on a different fauna.

I must now mention an incident of some importance in the history of Science. Either during this visit of the Grand Duke to Holland, in 1668, or during an alleged visit of Swammerdam to Florence, in 1678, he showed that Sovereign and his Court that when a portion of a muscle of a frog's leg, hanging by a thread of nerve bound with a silver wire, was held over a copper support so that both nerve and wire touched the copper, the muscle immediately contracted. This is nothing less than an anticipation by a century of the famous initial experiment of Galvani!

Swammerdam's experiment, however, led to nothing. The phenomenon produced was too remote from the ordinary sphere of his studies, his time and energies were fully preoccupied, and there was no Volta to interpret the fact. Otherwise we might have been in these days speaking of Swammerdamic batteries, Swammerdamometers, and the Swammerdamic current—cumbrous words, it must be confessed.

About this time Swammerdam denied the reputed acidity of the pancreatic secretion, and was engaged in consequence in a fresh controversy with Rynier de Graaf, and with his old master Sylvius de la Boe, whom he finally refuted in 1672.

In 1669 he wrote the larger part of his great history of insects, which, however, he did not at once publish. He had got together upwards of 3000 species of insects,—a large collection for the seventeenth century,—and had examined them with a care and an accuracy which hitherto had had no parallel. He had dissected most of the species, traced their development from the larva—or whenever possible from the egg—to the mature form, and had refuted the fabulous notion, handed down from the days of classical antiquity, that they are or may be generated from putrescent matter. He laid the foundations of the anatomy of insects. He devised a kind of dissecting microscope, and introduced the use of scissors for delicate operations, as being less liable to tear the tissues than knives. He injected coloured fluids, in order to render the different parts more distinct and to show their connection. For this purpose he employed minute glass tubes. He had not, of course, at his command the high magnifying powers of the modern microscopist, nor the polarising apparatus, but the general accuracy of his descriptions and his drawings has often excited the surprise and admiration of modern observers.

In the course of the year 1669 he encountered a new and very serious trouble, which continued almost to the end of his life. The elder Swammerdam would rather have seen his son a routine practitioner, writing out prescriptions and pocketing fees, than a brilliant discoverer. Hence a quarrel resulted. The old apothecary threatened to stop his son's allowance if he did not immediately give up his researches and devote himself to practice. By way of appeasing his father he undertook to clean, re-arrange, and catalogue the family museum,—a laborious task, for which a man of much inferior abilities would have been amply sufficient, and which to him was both waste of time and weariness. He was, however, physically unequal to the fatigues of medical practice.

In 1670 he had another attack of illness, and was forced to retire into the country for change of air and rest. His rest, however, consisted in completing his treatise on the Ephemera, which was not published until the year 1675. The following year he sent his plates of the anatomy of the human uterus, which had been drawn in 1667, to the Royal Society, accompanied by a series of injected preparations and a full account of his methods.

So far we have seen him bravely struggling on amidst all the difficulties of failing health, scanty means, and family discord, yet sustained by the pure love of truth. But a sad

change was impending. There had sprung up about this time a female fanatic, Antonia or Antoinette Bourignon. Had this woman lived in our "advanced" days she might have become an ethicist, a Bestiarian, and have written "Perfect Ways" or "Peaks of Darien." In the seventeenth century, however, such resources for abnormal women did not exist, and the Bourignon accordingly became a sect-founder and heresiarch. What were her especial tenets the readers of the "Journal of Science" will scarcely trouble themselves to inquire. Suffice it to say that her sect was anathematised by the Kirk of Scotland, and that she, like not a few kindred spirits, whilst eager for power and influence, was in no way blind to her private interests.

Some of her books fell, in an evil hour, into the hands of Swammerdam, who unfortunately read them and felt interested in them—a circumstance perhaps due to his morbid condition. He felt a desire to know more of her teachings. A friend did him the ill-service to effect an introduction. Bourignon, who was then living in Holstein, flattered, perhaps, at the prospect of enlisting among her followers a man of high reputation, allowed him to write to her, and vouchsafed to answer his letters. She soon acquired a strange and unexplained ascendancy over him. He did not presume to publish anything without her formal permission. She taught him to regard scientific research as a "worldly" and sinful waste of time which might better be devoted to mystical reverie. It is singular how in this respect her teachings practically coincided with those of some of our modern ethicists, who, though certainly not overburdened with religious beliefs, tell us that research makes us neither better nor happier, and is therefore a waste of time! The one and the other of these misleaders ignore the fact that with certain minds the search after truth is a ruling principle, quite independent of any benefits, outward or inward, which may arise. With us the craving for knowledge is just as much its own justification as is the craving for goodness.

We must again pronounce it strange that a man so independent, so fond of his own way as was Swammerdam, should allow himself to be dictated to by an ignorant fanatic. He who had rejected, it is said, with scant courtesy, the liberal offers of the Grand Duke of Tuscany, does not rise in our estimation when he becomes the vassal of a Bourignon.

Meantime he still engaged in researches on hernia, proving that it does not involve a rupture of the peritoneum. He

exhibited the spore-capsules of the so-called male fern to Arnold Syen, then Professor of Botany at Leyden. His illustrations of the spores themselves and of the sporangia are the same as those given by more recent authorities.

His last great task, however, was the completion of his treatise on Bees,—a work involving immense labour. Daily from 6 a.m. till noon he was engaged in dissecting and drawing. And this work he could no longer perform, as formerly, with unmixed satisfaction. Bourignon continually upbraided him, in her letters, for his devotion to "worldly" pursuits. In the language of Bœrhaave he laboured "amidst torments and agonies of mind and self-reproaches." When his task was completed he threw the manuscript and drawings on one side, and seemed utterly careless as to their destination. Either this treatise or his letter to Bocconi on the growth of coral must be regarded as his last work. In this epistle he regards coral as a cryptogamous plant analogous to the ferns,—an error which he would assuredly not have embraced if he had enjoyed the opportunity of studying them whilst growing.

We thus come to the end of his researches. It is said that he burnt a considerable proportion of his manuscripts in obedience to Bourignon, and that others would have shared the same fate had they not previously been sold to Thevenot. Any attempt to introduce scientific conversation now, so far from giving him pleasure, led merely to an outburst of anger, which might have been ludicrous had he been less to be pitied.

Swammerdam's only wish seemed now to retire from the "world," and devote the residue of his life to meditation. The family troubles did not subside. The elder Swammerdam broke up his house, and went to live with his daughter and son-in-law, leaving our poor misguided naturalist homeless. In this extremity he attempted to sell his museum, but found no purchasers. In fact his natural perverseness of disposition and his devotion to Bourignon had repelled many of his former well-wishers. His old friend Steno had accepted an official position at Florence, had joined the Catholic Church, and had been raised to the dignity of Bishop, *in partibus*, of Titiopolis. The news of Swammerdam's distressed condition having been carried to Italy, this prelate, at the instigation of the Grand Duke, reopened the negociations of 1668, offering his former friend and colleague the sum of 3000 crowns for his museum, and promising him an asylum at the Florentine Court. At the same time it was hinted that his adhesion to Catholicism, if not an

imperative condition, would be favourably construed. Swammerdam was furious, and upbraided his old friend as an apostate.

At last the death of his father, in 1677, put an end to his financial difficulties, though his sister and her husband secured the lion's share of the inheritance. The family museum, when disposed of, fetched but a small fraction of its estimated value.

The relief, however, came too late. Swammerdam's health was hopelessly ruined by repeated attacks of ague and by the debility consequent upon overwork, and often insufficient diet acting upon a constitution feeble from the beginning. But even if his health had been preserved he would have been, thanks to the influence of Bourignon, lost to Science. He died in 1680, or, acccording to some authorities, in 1682.

In endeavouring to judge of his position in the history of biological Science, we must not overlook the shortness of his career. Dying at the early age of 43, or at the longest estimate of 45, much of his time being wasted by sickness and the last six or seven years rendered a blank at the dictates of fanaticism, we can only wonder how he contrived to crowd so many important discoveries into so narrow a span.

He had in the highest degree all the attributes which mark the eminent observer. In delicate and subtile manipulation, in contriving new methods to meet every case, in acute and accurate perception, he has never been surpassed and rarely equalled. Above all he must be remembered for his untiring industry and perseverance.

As a generaliser he was much less distinguished. His entomological classification, based essentially upon their development, and especially upon the peculiarities of their pupa state, had merely the value of bringing the so-called transformations of insects into notice, and is now without any save a historical interest. His lack of a definite nomenclature is a great drawback. Were it not for the figures in his "Bibliæ Naturæ" many of the species described could not be identified.

His works contain a large admixture of teleological passages, and generally speaking of moral reflections, much more dyspeptic than philosophic, and remarkable neither for depth of thought nor grace of expression. These meditations remind the reader irresistibly of the morals formerly "tagged" on at the conclusion of a dramatic work.

Had he but possessed a vigorous constitution he would

have been greater both as a *savant* and as a man. Nevertheless, whilst we regret his weakness, we must hold him in high honour for the good and abundant work which he performed. It is sad to see in some biographical works he occupies a less space than is allotted to Bourignon. Figuratively speaking the *Phylloxera* is honoured more than the vine!

IV. THE DUKE OF ARGYLL'S REIGN OF LAW AND UNITY OF NATURE.

By James Simson.

In my "Contributions to Natural History, &c.," published at Edinburgh and in London in 1875, and with an Appendix in 1880, there is an article entitled "The Duke of Argyll on the Preservation of the Jews" (pp. 161 to 170), called forth by a remark in his "Reign of Law," in which he said:—"The case of the Gipsies has been referred to as somewhat parallel. But the facts of this case are doubtful and obscure, and such of them as we know involve conditions altogether dissimilar in kind."

To this I replied that "I should not imagine that he knows personally much of either, particularly the Gipsies. His remark is too short, vague, and obscure to admit of any comment being made on it. For a full discussion of the two questions I refer him to the 'History of the Gipsies,' which was published a year before the first edition of the 'Reign of Law' appeared, and two years before the fifth edition, in which corrections were made to meet criticisms on various matters treated in it. I may add that the subject of the Jews is not so well known to the world at large as to justify the many positive assertions that have been made in regard to them" (p. 164).

The same article was appended (pp. 38 to 47) to the "Scottish Churches and the Gipsies," published in 1881. I have not seen any notice taken by the Duke of what I wrote in reply to his remarks about the Jews and the Gipsies. In the Appendix to "Contributions, &c.," under the heading of

"The Endowment of Research," I said:—"On the face of it one would say that the Duke would *not* do any of the following things: 1st, maintain as true what he does not believe to be so; 2nd, advance as truth what he does not know to be fact or fable; 3rd, maintain a personal or popular dogma as a truth until the contrary is demonstrated; 4th, refuse to acknowledge that any position taken up by him is unsound on its being proved to be so, or that there is no reasonable foundation for it; and 5th, allow his opinion to influence others on any subject he may have maintained after it has been proved to be fallacious" (p. 199).

The position taken up by the Duke in regard to this matter is as follows:—"It is not surprising, therefore, that the preservation of the Jews . . . . is tacitly assumed by many persons to come strictly within the category of miraculous events." To this I replied thus:—"Why should that be *assumed*, tacitly or otherwise? What if it is only a 'vulgar error,' started by some person now unknown, and echoed by others after him?" (p. 162). The Duke further said that the preservation of the Jews is "a striking illustration how a departure from the 'ordinary course of Nature' may be effected through the instrumentality of means which are natural and comprehensible."

In the article I went very fully into this subject, and among other things said that "the isolation of the Jews is in exact harmony with the customs and genius of that part of the world where they originated and had their existence as a people, and which has been increased immeasurably by the special genius of their nation, from the call of Abraham, that it was to exist distinct from all others, and continue so for ever. And the Jews have been so persecuted or disliked by other nations that they have never, as a people, had the opportunity of 'amalgamating and becoming lost among others,' assuming that they ever had the wish to do it" (p. 163). "I have discussed the subject pretty fully in the work, showing that the existence of the Jews since the dispersion is in exact harmony with even natural law, and that it would have been a miracle had they ceased to be Jews, and become anything else than what they are to-day, and that there is no analogy between their history and that of any European nation" (p. 161), and particularly owing to them all being "children of Abraham and Sarah." "Paradoxical as it may appear, the way to preserve the existence of a people is to scatter it, provided it is a race totally distinct from those among whom it may be cast, and has inherent peculiarities calculated to keep it separate from others;

and more especially if it is also persecuted, or forbidden or barely tolerated to live among others. Its idea of nationality consists in its existing everywhere in general and nowhere in particular" (p. 162). "It is quite sufficient for the Christian to know that the Jews exist, and that they have fulfilled, and will yet fulfil, the prophecies that have been delivered in regard to them. . . . He should be more considerate in his estimate of what a miracle is, and not maintain that the existence of the Jew is one, for nothing having the decent appearance of an argument can be advanced in support of such a theory" (p. 164).

The preservation of the Jews, in common with that of the Gipsies, is a question of considerable importance, apart from it having been erroneously advanced as a "miracle" in support of Christianity. Neither is an exception to the "Reign of Law," but the strongest point in relation to race or nationality that could be advanced in support of it. The Duke says that his "Unity of Nature" is a continuation of his "Reign of Law," as applicable to Christian Theology. For this reason alone I think that the preservation of the Jews and Gipsies become subjects of not a little interest. In their discussion they should be taken up entirely on their merits, so that "preconceived opinions, prejudices, and dogmatisms" would be out of place in the treatment of them.

New York, February 26, 1884.

V. SCIENTIFIC NOMENCLATURE.

By Frank Fernseed.

SURELY I have fallen upon a dry, dull subject, repugnant to the outsider, and for which even the normal *savant* cares little, leaving the matter by preference to the indiscretion of eminent men. For all this it is high time that something should be not only said, but done. Hence though I have neither the power nor perhaps the right to dictate, I feel bound at any rate to propose and suggest.

I shall begin by admitting that in every science a fixed—and if possible an international—nomenclature is necessary, as well for the objects we study as for the changes they undergo and the operations we perform on or with them. We want names for animals, plants, minerals, chemical compounds, stars, &c., just as we need them for men, towns, or countries. Without such names our observations and experiments are a mere waste of time, since we can neither communicate our results to others, nor even preserve them for our own future reference. Hence, therefore, we need a precise nomenclature. There must be no room for doubt, at distant places or in future times, as to what species or what object our researches refer. One of the chief difficulties encountered in utilising the scientific works of antiquity, or of the earlier ages of the modern world, depends on this very lack of nomenclature.

But here, at the very outset, we meet with a difficulty which splits up the followers of Science into two hostile camps. They will all agree that the names we employ should not be taken from the living language of any civilised nation, since they would thus be *ipso facto* objectionable or useless to other nations. They will grant that our nomenclature should be formed from some dead or dying tongue, which may be the common property of all. Some even restrict this principle, by insisting further that the Greek and Latin languages, and no other, should supply us with the needful material.

The next requisite is that the names of species—organic, mineral, or chemical—should, like the names of stars, be very short. The reason for this is that long names needlessly burden the memory, and occasion much waste of time in transcribing and labelling. One of the greatest educational advantages of the physical and natural sciences, as distinguished from classical and linguistic studies, is that the latter appeal almost exclusively to the faculty of verbal memory, whilst the sciences cultivate mainly the power of observation and of interrogating Nature systematically, and of drawing right conclusions from the phenomena observed. Now the more cumbrous and long-winded we make our nomenclature, the more we sacrifice this advantage, and make Science an affair of memory.

Here, then, the question is raised—What can we fairly and justly demand from the name (say) of a plant, or a fish, or a mineral, or a chemical compound?

To the one party, among which I must claim to be included, the name is merely a mark for identifying the thing.

It serves as a pigeon-hole into which we thrust all our knowledge bearing upon such thing, or a file or clip for holding the whole together. In itself it need have no feature save brevity. If without sacrificing brevity it can be made significant, so as to convey any piece of information concerning the thing named,—for instance its locality, its colour, its habits, or any other property,—so much the better; but I, for one, am quite prepared to sacrifice all "significance" if it can only be purchased by the use of words of ten or twelve syllables.

The other party insist upon it as a something essential that a name shall embody as much as possible of our knowledge, or our opinions, concerning the thing. By so doing they present us with names which few people can remember so as to use in speaking, and which it is even very difficult to transcribe without stopping in the middle and referring to the original. Clerical and typographical errors are thus greatly encouraged.

That "significant" names have some advantages it need not be denied; but, as it has been often complained, these advantages are too dearly bought. To take a parallel case, it might often be convenient if the name of a man revealed to us the place where he was born, the maiden names of his mother and his grandmothers, his political and his religious creed, his balance at the bank, &c. But as a name to effect all these purposes would be exceedingly cumbrous, we find it simpler to call the man John Smith, understanding, rather than expressing, all such points as we know concerning his pedigree and his other attributes. This is every way more convenient, and a less strain upon our memory. Why should the case be different with, *e.g.*, chemical compounds?

It must be had in remembrance that the information conveyed to us in a "significant" scientific nomenclature consists generally not so much of facts as of opinions and theories. Time then rolls on, theories are laid aside, and a new name becomes necessary. This constant re-baptizing of objects is a serious hindrance to the spread of sound knowledge. The worst case is when a name is taken away from one body and applied to another. As an instance I may mention the salt sodium hyposulphite, familiar to photographers. This name has been confiscated and handed over to the compound which Schützenberger and De Lalande had named sodium hydrosulphite, and which they used, *e.g.*, in the reduction of indigo. Meanwhile the original hyposulphite is dubbed sodium thiosulphate. Suppose, then, we

find in a chemical work, or in a memoir, some mention of "sodium hyposulphite," we do not know which compound the author means. We may have to consider the date of the book, and reflect whether, according to our former knowledge of him, the writer accepted or rejected this change in nomenclature. If these clues are wanting, we have then to judge which body is signified by our knowledge of its properties. Thus, in fact, the main advantage of a precise scientific technology is sacrificed to the rage for "significant" names.

I must, however, not forget that to one class of minds such revolutions are welcome. Certain authors are immediately engaged in translating the old matter into the language of the new theory, and can thus acquire a certain reputation without discovering a single fact or making in any way the slightest addition to the sum of human knowledge.

In sciences where nomenclature does not depend on theories such troublesome changes are avoided. The astronomer applies still to the planets and the fixed stars the same names that were used in the pre-Newtonian or the pre-Copernican times, new appellations being needed only for heavenly bodies since discovered. This permanence in terminology is rendered possible by the fact that these names are not linked to any theory, and aim merely at identifying, not at defining or describing, their objects.

In Chemistry, as I have already intimated, a long, cumbrous nomenclature, intended to define rather than simply to mark out, has reached its greatest height, and become a crying evil. This circumstance is perhaps due in no small part to the fact that the modern development of the science, especially of that portion which deals with the compounds of carbon, has been chiefly in the hands of the Germans. This nation, not merely in scientific matters, but in the affairs of common life, seems to delight in a long-winded, sesquipedalian nomenclature. Their books, their journals, their societies, the titles of their officials, &c., have names disagreeably long for quotation or reference. Where we and our American kinsmen are content to identify, they still seek to add all manner of circumstances. What wonder that they have carried the same habits of thought and the same principles into their chemical nomenclature?

In Mineralogy, though many defects are to be recognised, yet upon the whole a healthier spirit prevails. A new insight into the composition of a mineral does not necessarily lead to a change of name. The names, too, are for the

most part free from any attempt at significance, and consequently can suffer little from any change of theory.

We come now to the organic sciences, where the wonderful changes wrought out by Darwin and his coadjutors have so far not been thought to involve a re-naming of the entire vegetable and animal kingdoms. The so-called binary nomenclature, commonly ascribed to Linnæus, is really due to Pierre Belon, of Mans, who laid down its principles as early as 1558. But there is a feeling "in the air" that this system has had its day, as not lending itself to the discrimination of sub-specific forms. We must indeed admit that, with all its advantages, the Linnæan system is better adapted to the hypothesis of permanent and unalterable species than to that of ever-changing forms. Let us hope, however, that when—if ever—the new nomenclature is constituted it will not be built upon the lines of the supposed evolutionary pedigree of each species. *Equus caballus* may not be a faultless name for a horse; but suppose in its stead one in which *Orchippus*, *Anchitherium*, and *Hipparion* are interwoven, every additional step in research involving a re-naming!

In the meantime the rage for significant names has made itself felt as regards more recently discovered species, and with the necessary results. The older names connote nothing, and simply denote the genus or species to which they are applied. Thus no one, save perhaps a philologist of the calibre of Prof. Max Müller, can find any meaning in the word *Rosa*. Yet it makes as good a generic name as does *Trigonogenium*, *Tmesorrhina*, or *Dicranocephalus*, and is much more easily pronounced and remembered.

I cannot sympathise with those who think every name of origin other than Greek or Latin should be necessarily excluded. Why, for instance, was *Moa* not permitted to remain as the generic name of the gigantic extinct bird of New Zealand? It is shorter and much more euphonious than the Greek word *Dinornis* which has been coined in its place, and, belonging to none of the "culture-tongues," might have been accepted in all countries. On the other hand, *Dinornis* has indeed a meaning,—"dreadful bird,"—but, as is often the case, one which tells us nothing concerning the locality, the habits, or other properties of the species.

I heard with surprise and regret, a few evenings ago, an eminent entomologist complaining that names taken from Hindu mythology had latterly been given to Indian insects. With all due deference I cannot enter into his feelings. These Hindu names are well marked, easy to remember, and if applied to species inhabiting the Oriental Region

will at once mark their locality. On the other hand, I can most cordially protest against some recent barbarisms. When a writer concocts such names as "*Darwinhydrous*, *Tyndallhydrous*, *Huxleyhydrous*, and *Spencerhydrous*," we may well ask, in alarm, what next? The answer is perhaps supplied by the American entomologist who named an unfortunate beetle *Carabus know-nothing*.

But besides the names given to genera and species, some of a highly complex and ultra-classical character have lately been introduced into various departments of Biology. Surely a movement of this kind is a mistake when an increasing number of persons are studying Natural Science who are not classical scholars. No less surely the mistake is intensified if such words are introduced by an eminent official *savant* who opposes the predominance of classicalism in higher education, and yet by manufacturing such words makes it almost compulsatory. Needlessly to multiply technical terms of *any* origin is, I submit, a grave error. It is sad to see an able morphologist using such terms as "caudad," "cephalad," and the like, when tailwards, headwards, &c., would express his meaning as precisely and more intelligibly.

It will not, I trust, be thought an aimless digression if I call attention to the confusion which may arise from the use of one and the same term in various branches of Science with a different meaning. As an instance we may take the term "function," used both in Physiology and in Mathematics. In the former, or rather in Biology generally, function is the particular work performed by some organ or tissue. Thus the decomposition of carbonic acid under the influence of light is the function of the chlorophyll granules of plants; respiration is the function of the lungs, the gills, and the tracheæ of animals, digestion of the stomach, &c. In Mathematics, on the contrary, a quantity is said to be a function of another, or of several others, when its value depends upon that or those of the latter.

Such terms very rarely occasioned any ambiguity in former days, when the different sciences stood more isolated and more aloof from each other; but now they supply each other not unfrequently both with facts and methods, the confusion is beginning to be felt. Thus since quantitative determinations have been more and more introduced into biological researches, we may in them meet with the term "function" in its mathematical sense.

A similar confusion may arise with the term "elements." Thus we have the "elements" of Chemistry, the undecom-

posed and assumed undecomposable bodies; in Astronomy "elements" are the data necessary for ascertaining the place of a planet or comet; in Electricity an "element" is a unit of a galvanic combination, &c. Many more such instances might be sought up if it were needful to furnish a catalogue.

There are two words, not strictly belonging to scientific nomenclature, which should here be considered; both have outgrown, or rather have grown away from, their original meanings, and hence call for a re-adjustment.

The word "museum" is now, in England, applied to two classes of establishments which, save the name, have very little in common. The one class is simply Wardour Street on a magnified scale. It is fitted with objects of human production, and illustrates the career of art, "fine" or industrial, and the waverings of fashion.

Museums of the second class are destined for the reception of specimens illustrative of some science, and which are, or might have been, the products of Nature. Class I. receives old furniture, bric-a-brac, clothing, pictures, statues, idols, weapons, and the like. Class II. is for geological, mineralogical, botanical, and zoological specimens. As a rule it will be found that the persons who take an especial and a thoughtful interest in the one kind of museum will care but little about the other. The mere holiday sight-seer alone will stroll through both as he hastens to his great attraction, the refreshment-room—that recent and injudicious appendage to museums.

It may, however, be said that articles of human production illustrate, at any rate, one Science which of late years is receiving great and wide attention throughout the civilised world. This is true: articles of "bigotry and virtue" may be viewed as ethnological, or indeed as anthropological, documents. But whilst admitting the difficulty here, as in all our classifications, of drawing a hard-and-fast boundary line, I would suggest one which may be adopted for the sake of convenience. Let all products of pre-historic art be referred to the Museum of Science,—all of a later age to the Museum of Art and Industry.

We need, then, two distinct words for museums of these two classes, to save the necessity of explanations.

The other word to which I refer is Aquarium. This name was first given to receptacles of water, large or small, in which the development and life of aquatic plants and animals might be conveniently studied. So far all was well, the only question being whether Aquarium or Aqua-vivarium should be accepted as the correct term. John Bull's craving

for brevity in language (a laudable feature!) for once carried the day against his love for classical precision, and Aquarium became the accepted term.

But now came the misfortune. Such a receptacle was found to have its entertaining as well as its instructive phase. The small Aquarium, from an appliance for the laboratory became an ornament for the drawing-room or the boudoir. The large Aquarium was seized on by speculative individuals or companies as an "attraction," and, in conjunction with other "attractions," was worked up into totalities differing very little from music-halls or "palaces of pleasure."

The typical English aquarium is no place for study, save that of human frailty; its fishes are chiefly of the order familiarly known as "loose," and its water is mainly, for internal consumption, qualified with alcohol. Promenade concerts, dances (I believe), and the feats of jugglers are offered in place of facilities for observation and experiment. In short the term has undergone a transformation as signal as did the word "bagnio."

Now I do not presume to dictate what should be the pursuits of my neighbours. But there is, I submit, good cause to complain if amusements of such a nature are carried on in places nominally at least devoted to Science. It is not well that one and the same name should be applied to such establishments as that of Professor Dohrn at Naples, or that at Watson's Bay in New South Wales, on the one hand, and the present English aquariums, on the other. We may, indeed, call the original unpolluted Aquarium a "Marine *Z*oological Station," or some such cumbrous name. But we want a brief compact word. Can none of our neologists coin a suitable term?

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 159.)

THE system of Technical Instruction carried out by the City and Guilds of London Institute will now be reviewed: the system is a copy of the Department's one in its general principles; all the errors and defects of the one system exist consequently in the other. The teacher is paid wholly on result system; the Examinations are merely written ones. The same set of Examiners appear always to be employed, as is the case under the Department; therefore what has been stated in former articles in condemnation of this mode of paying teachers, and testing the *quality* of the instruction given as adopted by the Department, applies in an equal degree to the Guilds' plan.

In the Guilds' Programme it is stated that the "Payments to teachers of Technological subjects, on the results of instruction in Technology, will be made generally in accordance with the same rules as those which regulate the payments made by the Science and Art Department to Science teachers," —that is to say, the teacher will not receive payment on results for every class of students, but only for those who are in receipt of weekly wages, and of their children, or persons in the receipt of not more than £200 a year, also their children, and teachers and pupil-teachers of some elementary schools. We draw attention to this *limitation* in the payments, because we shall bring under the notice of our readers presently the opinions of men eminently qualified from their occupations to form intelligent and correct views on the question, and it will be shown that their opinions do not accord with those who were the originators of this system.

Local Committees along with the Local Secretaries superintend the pupils, as under the Department's plan, during the time they are engaged in answering the questions set in the Examination papers. The Guilds do not, however, appear to have any inspection of their classes to see how the courses of instruction are given by the teachers, and yet, as was shown in the May article (vol. v.), this duty is a most important one, for good inspection will reveal more as

to the kind of instruction given in a school than the mere perusal of Examination papers. It was pointed out in the last article that the Department entrusted this important duty—*viz.*, the Inspection of their Science Schools—almost entirely to Officers in the Army.

Let me show my readers how authorities like the present Vice-President of the Science and Art Department, the Right Hon. A. J. Mundella, M.P., regard it. In his Examination before the Select Committee of Scientific Instruction, in 1868, he was asked the following question (4704):—"Are you aware that only about *two-thirds of the sums* granted for educational purposes are really disposed of for those purposes, *the rest* being absorbed in the Staff of the Establishment?" * Answer: "It is not to be wondered at, if you look at our Inspection: we have three or four classes of Inspectors, when one would do the work." In answer to another question he indirectly intimated what he thought of the quality of this Inspection by speaking in contrast with it of the excellent quality of the Inspection in German schools. But before giving the questions and answers it will be as well to inform my readers that Mr. Mundella, at the time he gave his evidence, had not only a large manufactory devoted to the hosiery trade, at Nottingham, but he had also a similar one at Chemnitz, in Saxony, where he employed between 700 and 800 hands; he was therefore well qualified as a manufacturer to express his opinion on the difference between the educational systems in the two countries. Question (4706): "Apart from the question how the Inspection should be conducted, do you not think that Inspection by a central authority is useful?"—"I think it is very useful and desirable." Question (4707): "Would that apply, in your opinion, to primary education alone, or to scientific instruction also?"—"Yes. In Germany even private schools must be inspected by the Government Inspector, who has to see that *no quack* assumes the office of teacher of middle-class schools, and the result of this system of inspection is that the inspection in Germany is *first rate*." I will here give one more question he was asked, and his answer, as the answer very strongly confirms some of the statements in the

* It is difficult to arrive at the exact sum expended on the administration, including the cost for Examinations and Inspections, in contrast with the teachers' payments (the payments on results) from any of the Department's documents on the subject. But as far as I can make out, after a very careful examination of the Estimates, the Appropriation Accounts, and other available public documents, I believe I am correct in stating that it is not two-thirds of the sums granted for educational purposes that is expended at the present time on those purposes, but that it is less even than 50 per cent.

last article. Question (4794): "What you would wish is that the English manufacturer should have the same advantage as the foreign manufacturer in scientific education?" —"Yes; and if he has those advantages I am sure he would hold his own." One of the Science teachers under the Department who gave evidence before that Committee said, with regard to the Inspection as it was conducted, that it was practically useless.

With three exceptions all the eminent manufacturers, including Mr. Mundella, who gave evidence before that Committee, and also the Professor of Engineering in the Edinburgh University, Fleeming Jenkin,—who before he was a professor had been both a mechanical and civil engineer in practice, and had carried out engineering works on the Continent,—all testified that it was not from want of skill on the part of our artizans, but from want of scientific and artistic knowledge on the part of our manufacturers, their managers, and foremen, that foreign manufacturers are equalling and will eventually surpass our own, unless these classes in England are supplied with a scientific and artistic education equal to that obtained by like classes on the Continent. The Committee stated in their Report—"There is a preponderance of evidence to show that so far as the workmen, as distinguished from the managers, are concerned, scientific knowledge can be considered an essential element only in certain trades, or, generally, as enlarging the area from which the foremen and managers may be drawn." Nearly every one of the witnesses attributed the extraordinarily rapid progress of Continental nations in manufactures, not to their model workshops,—for they considered these workshops but an indifferent substitute for our own great factories,—but mainly to the scientific training of the proprietors and managers in France, Switzerland, Belgium, and Germany.*

All the witnesses concurred in desiring similar advantages of education for this country, and were satisfied that nothing more *was required*, and nothing less *would suffice*, in order that we may retain the position which we now hold in the

* Mr. Bernard Samuelson, M.P., Chairman of the Royal Commission on Technical Education, stated a short time ago—"One of the great fallacies which prevailed was that foreign *workmen* were better educated than our own. In France and Belgium the education of the workman was spread over a larger area than it was with us, but the remark did not hold good with respect to other countries, even with regard to Art; and to suppose that the average workman on the Continent was receiving a superior technical education to that of the workman of this country was a mistake altogether, and ought not to be allowed to go uncontradicted.

van of all industrial nations. All were of opinion that it is of incalculable importance economically that our manufacturers and managers should be thoroughly instructed in the principles of their arts.

They were convinced that a knowledge of the principles of Science on the part of those who occupy the higher industrial ranks, and the possession of elementary instruction by those who hold subordinate positions, would tend to promote industrial progress by stimulating improvement, preventing costly and unphilosophic attempts at impossible inventions, diminishing waste, and obviating in a great measure ignorant opposition to salutary changes.

On the payment part of the question the Committee observed—"The remuneration of the teachers, arising from pupils' fees and payment on results by the Department of Science and Art, is, with few exceptions, *so scanty* that Science teaching is scarcely ever followed as a profession, but only as an addition to some more profitable employment. Hence classes are frequently suspended whenever the more important occupations of the teacher demand increased attention, or cause him to remove to other localities. As the demand for instruction increases the incomes of the teacher will doubtless increase likewise, but the want of competent men will still remain."

It is not from want of competent men, nor has it ever been so, that we have not had good scientific instruction given in the Science classes under the Department of Science and Art; it is, and has been, due to other causes. We will briefly enumerate a few: uncertainty as to what will be awarded for the labour and time given; uncertainty in the date of payment, when an award has been made; uncertainty in the duration of the employment, for under the system the teachers are entirely in the hands of the permanent officials at South Kensington: there is no appeal from their decision, however unjust, and those decisions may be made by some subordinate clerk in the Department. The result system, in fact, makes the teachers the servants of the permanent officers of the Department, and not the servants of the State. In the Department's Annual Reports it is always prominently put forward that Science schools continue to multiply, and that there is a continued increase in the number of pupils; therefore in this sense Science instruction has increased since the Committee reported, but, instead of the incomes of the teachers increasing, as the Committee expected, their average payment has decreased since that time by more than 38 per cent. Again, it is

within the power of the permanent officials, according to their Minutes,—Minutes which, according to Mr. Mundella, are rather *puzzling*,—to award no pay whatever to the teacher after he has given his course of instruction; but if he is awarded pay it may, as we have seen, be so *scanty* that it may not amount to 2¼*d.* per hour during the time he is occupied. The cost of the administration of the Science and Art Department—the Staff establishment—has in the meantime gone on increasing at a rapid rate, including the secure and permanent salaries of the officials; and new posts, to which handsome salaries are attached, continue to multiply. Is there not a cause, then, why competent teachers should not place themselves in such a humiliating and precarious position? Private employers could not obtain competent persons on any such terms; neither as a rule can the State obtain them.

But competent teachers are not able to teach efficiently under the system, for if they did they would earn little or no pay: "Science Teacher," in his letter which appeared in the last number of this Journal, states that fact, and Science teachers I have met with have stated the same thing to me. One of the Department's own Inspectors, in speaking to me some time ago on the subject, informed me that the most successful of the Irish Science schools he inspected—the most successful in the way of obtaining medals, prizes, &c.—the pupils were prepared by repeating answers every school-day to a certain number of the questions the Professional Examiners had given in previous examinations: in the course of the conversation he observed that it would be much better, instead of expending public money on the teaching of subjects which never could be of any use to the learner, owing to the way the subjects were taught, if the money was expended in teaching the young people some handicraft which would be not only of benefit to themselves but also to the country.

I have noticed these evils as they form part of the system; they must therefore, in a greater or less degree, pervade the system when carried out by the City Guilds.

The limitation of Science instruction, on the part of the Department and the Guilds, to the artizan class chiefly, is limiting it to the class which can least benefit by such instruction. Mr. Mundella, on being asked questions by the late Lord Frederick Cavendish, showed by his answers that he had no doubt as to the class to be taught if the nation was to derive any benefit from the instruction given. 4664: "Do you think it is necessary, in order to enable us

to maintain competition with other countries, that all persons employed in our manufactures should have some scientific education, or that such scientific education is chiefly necessary for manufacturers, managers, and foremen?"—"I think it is necessary *simply* for manufacturers, managers, and foremen." 4665: "You do not think it is necessary that ordinary mill-hands and mechanics should receive such instruction?"—"It is not necessary, certainly." The following question and answer shows what he thought of the *quality* of the instruction given under the Department of Science and Arts system, and the same will of course apply to the City and Guilds plan. 4635: "In Nottingham have you many classes in connection with the Science and Art Department?"—"Only two or three very small classes; you may call them Elementary Science classes: they are doing good work *I dare say, but there is no comparison between them and the Science instruction given abroad.* The scientific instruction given abroad is really solid instruction, but what we give at our mechanics' institutes, in a chemical class attended by about thirty persons, which is the only class in Science, is not instruction *of the same order.*

The witnesses recommended the continuance of evening Science classes; but the continuance of these classes was recommended far more for the sake of those who were or would be masters, managers, or foremen, than for the artizan class. They were very strongly of opinion that artizans, with the exception of a very small minority, would be unable, owing to the *exhaustive* toil they had to undergo during the day in the workshop or factory, to attend, at least with any benefit, to instruction given, especially if the subjects to be studied were of such an ever-progressive nature as those of the inductive sciences; they considered it was somewhat different if the subjects were of a comparatively non-progressive character, like mechanical drawing: drawing they considered might be studied with advantage by artizans.

The framers of this educational system for artizans—for when it was first started by the Department it was limited exclusively to that class, if we are to take the Department's puzzling Minutes as our guide—altogether *overlooked* that the energy each person possesses is *limited in quantity*, and therefore, as the artizan's energy is all or nearly all used up in the manual labour he performs during the day, he has consequently little or none left to draw upon for serious and exhaustive mental study in the evening: he likewise labours under another difficulty,—the education he received in his school-boy days was limited in quantity, and not unfrequently

very indifferent in quality. The mere learning scientific facts, such as that phosphorus will burn in oxygen, will be of no practical advantage to artizans or any other class: chemical science, for example, to be of any practical benefit to the taught and the community, must be carried far beyond such mere rudimentary teaching; and as the science is continually progressing, and at a rapid rate, the taught must ever continue the study—both in the laboratory and by study of the advanced chemical works—both on pure and applied science; it is too frequently left out of sight that the inductive sciences are ever progressing.

Prof. Fleeming Jenkin, in the *invaluable* evidence he gave before the Select Committee, said—"I do not see how a practical knowledge of Chemistry is to be of use to workmen who are employed to carry out manufacturing processes. It is impossible that they can have such a knowledge of the theory of Chemistry as would enable them to alter or modify the processes in any way; and I should think a little knowledge would be almost objectionable, if they were allowed to use it for such a purpose." Prof. Jenkin was speaking of the average workman, and I quite agree with him. A most valuable and instructive educational experiment, which was noticed in the April No. (vol. v.), has been tried at the Cornell University in America. It is this,—whether a student can work part of the day at manual labour, and part of the day at mental study, with success in the latter labour: the experiment has proved it to be impossible with the average student, for he has not sufficient energy for both mental and manual toil.

The quality of the instruction given both in the Department's schools and the Guilds' schools requires to be very greatly improved; instead of *quantity* being the primary object, as is the case at present, let *quality* be the first desideratum aimed at in the future: to gain this improvement it would be desirable to restrict the evening Science classes to towns in the first instance, and afterwards extend them to villages when required. Let the capitation fees, along with the students' fees, be sufficient to afford a competent teacher a respectable salary; let the maxim attributed to Confucius be adopted in the future with respect to the teachers—"If you suspect a man do not employ him, and if you employ him do not suspect him." In connection with this part of the subject I will quote one other remark made by the Commissioners: "There can be no doubt," they state, "that from the evidence of Mr. Mundella, of Prof. Fleeming Jenkin, Mr. Kitson, and others, and from numerous

reports of competent observers, that the facilities for acquiring a knowledge of theoretical and applied science are incomparably greater on the Continent than in this country, and that such knowledge is based on an advanced state of secondary education."

The Grammar schools in the country parts of England, especially those that have no scholarships or prizes to give away at the Universities, should be converted into schools where a modernised system of education was given, somewhat similar in character to the course given in the Real schools in Germany; and let some of the most talented boys in the National schools in the neighbourhood be promoted from time to time into these higher Middle-class schools, on a plan somewhat similar to that adopted in Germany. In this way the disadvantages the boys in sparsely inhabited districts might labour under, as regards educational training, compared with the boys living in towns, would be considerably overcome.

But we must return to the more immediate subject of the article, *viz.*, the City Guilds' scheme as regards evening classes, or perhaps it would be better to enlarge it by saying their elementary classes.

The City and Guilds confine themselves to Technical Education: it is unfortunate that this term "Technical Education" has more meanings than one attached to it: some people confine the meaning to the teaching of trades and handicrafts; others limit it to the teaching of Science and Art in their applications to different industries. It is mainly in the latter sense that it is employed by the City Guilds, although they appear in some cases perilously near entering upon the teaching of trades.

As regards the teaching of trades in schools, there are few trades that admit of even a semblance of being taught; the manufacture of sulphuric acid, soda ash, bleaching powder, the melting of ores,—in fact all our most important industries,—could not be taught in scholastic factories or workshops.

Moreover, the teaching or the attempt at teaching trades to the artizan class—for they would be the only class that would undergo the necessary manual labour attending such instruction—would very strongly tend to perpetuate one of the very serious evils we are suffering from as an industrial nation at the present time. For if the owners, or those who would in the future be the owners, of manufacturing establishments were led to believe that they could be supplied with trained workmen, however mechanically they

were trained, from institutions like the City Guilds, it would conduce very strongly to make them indifferent in learning the principles of their art; they would content themselves, as at present, with being *mere employers of labour*, leaving to others the acquiring of a knowledge of the principles on which their industries were based. And yet it is most desirable, for the owner's and nation's success, that he should have a sound knowledge of the principles on which his industry is based, for it would render him more earnest in his business, and it would much contribute to make him give personal attention to every detail; and according to Mr. Chance, the large glass and chemical manufacturer at Birmingham, "success in any manufacturing pursuit depends mainly upon the most minute attention to the smallest point which may be concerned in the perfection of the article to be produced, and that is why I think thoroughness of education is so important: a man who has had a thorough education will appreciate perfection much more than the man who has been superficially educated." A sound knowledge of the principles of his business also causes the manufacturer to take a greater pride in his employment, and it makes him keep himself better informed as to what is being done in other countries.

Mr. H. Ripley, the then Chairman of the Bradford Chamber of Commerce, insisted strongly before the 1868 Committee on a good scientific education for owners and managers, on account of advantages like those named that spring from it. I will give one question and his answer. Question (4267): "Comparing them (French and German manufacturers) with English gentlemen of the same order, do you think they are on the whole more intelligent, particularly on scientific subjects, than a similar class in this country?"—"I expressed an opinion on that subject years ago, and I expressed it again very strongly last year at Bradford, in the spring. I have come in contact with manufacturing gentlemen abroad whose friendship I could claim, and, from my point of view, these men are superior in scientific knowledge to gentlemen of a similar class in England; they are undoubtedly superior in scientific knowledge to any men occupying similar positions in England; they have appeared to me to be more in earnest than our manufacturers are on this subject, and I am ready to use the word "alarmed": the only thing that has alarmed me is the earnestness with which these foreign manufacturers are conducting their business, and the attention they give to every point of detail: comparing them with our own

manufacturers, I see a great want of earnestness here in many cases.

The number of students who were examined in Technological subjects by the City Guilds amounted to 1972 in May, 1882, and to 2397 in May, 1883; the cost of the examination of the students in May, 1882, is set down at £2378, or £1 4*s.* per head. In the Programme for 1881-82, the last I have got, the subjects to be examined upon amounted to 32; they include not only all kinds of manufacturing processes, but such subjects as bread-making, plumbers' work, silversmiths' work, watch- and clock-making, &c.

The Guilds place a very curious *limitation* on paying on results: to make this clear to my readers I will quote from their Programme:—"The students, on the result of whose examination the grants will be made, must be persons actually engaged in the industry to which the examination refers, or in some closely allied industry. They will be required to obtain their employers' signature to a form testifying to this fact." The Guilds do not therefore, for example, give a complete technological chemical course, but they teach, or attempt to teach, the chemical principles involved in alkali manufacture to those who are engaged in alkali works, the principles involved in gas-making to those who are engaged in gas works, &c.

Do the City Guilds intend to have this limitation in their higher scientific schools or colleges? if not, on what principle do they carry out this limitation in their Elementary schools? The limitation would almost seem to imply that they think there is a different chemistry for each particular manufacture. I, and others who like myself have carried out original investigations in chemical factories, and have also had *actual* superintendence of chemical factories, and large and varied experience in teaching the science in the laboratory and lecture-room, do not think students gain very much real knowledge by attending even complete technological courses in Chemistry. For if the student has received a very sound and thorough course of instruction in the laboratory—and still more, if he has received a training in conducting chemical investigations—he has the same means of access, with *equal knowledge*, to the sources of information of Chemical Technology, as his teacher, especially if the teacher has had no practical experience in any chemical factory, and whose chemical technology teaching is therefore limited to what he has gained from books and from *visiting* chemical factories. But when the technological teaching is

limited to the industry in which the student is engaged, as it is under the City Guilds system, it may be classed almost correctly as "rule-of-thumb teaching."

Prof. Bayer, the first discoverer of the mode for producing artificial indigo, when asked by our Technical Commissioners how long he would recommend that a technological student should be engaged in studying and working at theoretical chemistry during his studentship, replied, "I would make it firstly chemistry, secondly chemistry, and thirdly chemistry." In other words, if the science has been thoroughly grasped, the applications will take care of themselves, for the student who has been so trained and instructed in the science is rendered competent, as far as instruction will,—for instruction cannot endow a man with ability to apply his knowledge, who has no natural talent for applying it,—to apply his knowledge *not to one but to any* chemical industry.

But the *limitation* is not the only blot in the City Guilds elementary course; another and very serious defect is the very small modicum of science they require on the part of the student they undertake to instruct in Technology. I will here reproduce what I have stated on this part of the subject in my work on Education, "Scientific and Technical." I believe the Technical Examinations that are being carried out by the City Guilds of London Institute are not likely to prove of much, if of any, advantage to the country. I allude to the examinations in such subjects as brewing, calico-printing, the smelting of ores, &c. Their inutility will arise not on account of any deficiency in the divisions of the subjects examined upon, nor from the questions given, but from the slender stock of knowledge that is required for passing them: thus for the full technological certificate for brewing, it is required of the candidate that he has previously passed—at least in the *elementary stage*—one of the following subjects at the Department of Science and Arts examinations:—

Machine Construction and Drawing.
Building Construction.
Theoretical Mechanics.
Applied Mechanics.
Inorganic Chemistry.
Organic Chemistry.

Of these six subjects only the last two would be of use in passing the examination on Brewing, as given in their Programme of 1880; and the majority of the students who pass the Department of Science and Art examinations—at least

in the elementary stage—have no practical knowledge of the sciences they pass in; they have acquired their knowledge generally, not by studying the science practically, but from books or lectures; it is consequently not a knowledge *of things, but only of names of things.* It appears to me that in both sets of examinations, *viz.*, those in Pure Science and those in Applied Science, to use the words of Prof. Williamson, "It is just wasting the time of students, instead of doing that which really might be of permanent use to them; and they are sent out as conceited fellows, who are simply a nuisance to the factory, if they do work in it, instead of modestly beginning to learn the practice at the bottom."

Sir William Thomson stated before the Committee of Scientific Instruction—"I have a general feeling that a Chair of Technical Chemistry has nothing to teach that is not better learnt in a manufactory. There is only one Chemistry, and that is *true Chemistry;* and it is much more desirable, therefore, for those who are going into a chemical manufactory to know true Chemistry than that which would be of the most trivial value to them,—namely, to have attended courses of lectures upon the processes of calico-printing and bleaching, and the manufacture of colours, elaborately described, with illustrations, which the students are better able to see in the workshop."

(To be continued.)

Note to Article on VACCINATION *in our last.*

• These high percentage figures have been taken as proof that the epidemic of 1871-2 was of exceptional severity; but they are simply a statistical delusion, or, rather, the statistical proof of the existence of a delusion, seeing that no more die in the total than before. To illustrate:—In 1871-2, the proportion of vaccinated to unvaccinated patients is given as 75 per cent, with a total fatality of 19 (18·66) per cent. The relative fatality of unvaccinated to vaccinated is represented as four to one, giving percentages 44·8 and 10·15. Now, if the proportion of vaccinated to unvaccinated patients became 90 per cent while the total fatality, and the relative fatality of the two classes, remained the same, the percentage fatality of the two classes would appear as 60 and 15 respectively, although all the actual conditions affecting mortality continued unaltered. If the proportion of vaccinated patients, under the same conditions, were raised to 95 per cent, the percentage figures of the two classes would then be 68 and 17. Contrariwise, if the vaccinated declined to 10 per cent of cases, the corresponding fatalities would appear as only 20 and 5.

G. S. GIBBS, F.S.S.

ANALYSES OF BOOKS.

Coffee and Tea. A Lecture given at the Parkes Museum on December 6th, 1883. By G. V. Poore, M.D. London: H. K. Lewis.

In these reforming days coffee and tea are pronounced no less pernicious than wines and malt liquors. Even a draught of spring-water is forbidden us, and we are told by meddling innovators that hot water, heated just so strongly as not to prove an emetic, is to be the "drink of the future"—poor future! Dr. Poore, however, has the courage not to regard this clamour. He speaks out boldly in praise of tea and coffee, and does not even pass a sweeping condemnation on alcoholic beverages. He tells his hearers that a properly controlled appetite or instinct is as safe a guide in the matters of diet as a physiologist or a moralist. Safer by far, we should add, than the latter! We read here further:—"The argument is often put forward that as the lower animals do without tea, coffee, &c., so ought we; but to this I would humbly oppose the fact that we are *not* lower animals, that we have *minds* as well as *bodies*, and that since these substances have the property of enabling us to bear our worries and fatigues let us accept them, make rational use of them, and be thankful."

We should be the last to maintain that a regimen fitted for one species is all sufficient for another. We fully recognise the fact that man—modern man, and perhaps most of all English and American man—has, by a *curiosa infelicitas*, placed himself in abnormal conditions, so that what is natural is no longer the question. Perhaps when the "equal rights" of the lower animals have been acknowledged,—when "national conscience," *i.e.*, the exigencies of party, has led to their enfranchisement,—and when they have been handed over to the tender mercies of the Committee of Council on Education or the Science and Art Department, they too will find the necessity of tea, coffee, or even hashish. Meantime we submit that, like ourselves, they have "minds as well as bodies."

Dr. Poore describes the peculiar physiological effects of tea and coffee, and shows how completely they differ from those of alcohol. He discusses the relative dietetic value of a cup of tea as compared with a cup of coffee, pronouncing the latter to have double the value of the former. But this conclusion is based

upon German researches, and everyone knows that the infusion known in Germany as "Thee-wasser" is exceedingly feeble.

We find here due mention of tannic acid as one of the dangers of tea, especially for the poorer class of consumers. Anxious to extract anything of value from a modicum of tea, they allow it to "simmer on the hob for an indefinite period, with the result that a highly astringent and unwholesome beverage is obtained. There can be no doubt that the habit of drinking excessive quantities of strong astringent tea is a not uncommon cause of that atonic dyspepsia which seems to be the rule rather than the exception among poor women of the class of sempstresses." It is evident that the use of a solution of tannin along with albuminous or gelatinous matters is a royal road to indigestion. The "tea-dinner," or "high tea," is a grievous mistake.

Coffee, however, is the author's main subject, being of the two articles the less understood in this country. He points out that it should never come in contact with metal at all. It should be bought not merely unground, but raw, kept for use in a stoppered glass bottle, roasted in an earthenware pipkin, pounded in a mortar with wooden pestles, and prepared in a stoneware pot. With the exception of the pounding in place of grinding—a process peculiar to Turkey—these are the rules followed on the Continent. Brillat-Saverin is here quoted as having made a careful experiment to test the comparative virtues of grinding and pounding. He carefully roasted a pound of good Mocha, and divided it into two halves, grinding the one and pounding the other. A jury of gourmets decided that the decoction made from the pounded portion was superior in flavour and aroma.

We thoroughly agree with Dr. Poore in his repudiation of chicory. It was an evil hour when, at the instance of one of whom it has been said that he was, "as touching the righteousness that is in red tape, blameless," the sale of coffee mixed with chicory was officially sanctioned. But into this subject we cannot enter. It may be well to glance at the scandalous falsehood of "Coffee as in France, a luxury unknown in England." In France people buy their coffee unground, very generally unroasted, and roast and grind every morning for the day's consumption. Those who use chicory add it themselves in known proportions, and are not simple enough to buy chicory worth (say) 3½*d.* per lb. at the price of coffee.

This lecture contains instruction greatly needed by the British public, and we hope it will lead some of its readers at least to desist from the stupid practice of buying ground coffee.

Proceedings of the Literary and Philosophical Society of Liverpool (during the Seventieth Session, 1880-81). No. XXXV. London: Longmans and Co. Liverpool: D. Marples and Co., Limited.

FROM a variety of causes, into which we have no occasion to enter, this volume is somewhat late in making its appearance.

Of the memoirs printed three only, or at most four, come within the legitimate scope of our cognizance.

That the Inaugural Address of the President, Mr. E. R. Russell, concerns us little may be readily expected if we call to mind an utterance of his contained in an Essay on "Trevelyan's Life of Macaulay." The subject of the Address is "The Independent Prerogative of the Understanding in the Domain of Moral Judgment."

A memoir on the "Dimensions of the Stellar Universe," by R. C. Johnson, F.R.A.S., is a summary of existing knowledge rather than a record of newly-discovered facts or of original generalisations. The author's objects are to explain the difficulties which baffled all attempts prior to the invention of the telescope, to ascertain the distances of the stars, to describe what is known concerning the stars so measured, and, lastly, to show how from this knowledge there is being gradually elaborated "a scheme that may possibly comprehend the physical connection of remoter stars and systems." These points are expounded with clearness and ability.

A paper by the Rev. Thomas Hincks, F.R.S., "On a Collection of Polyzoa from Bass's Straits, presented by Capt. W. H. Cawne Warren to the Liverpool Free Museum," records good original work. This collection was placed for examination in the hands of Mr. Hincks, well known as one of the greatest living authorities in this department of Zoology. It contains no fewer than 90 species, of which 23 are new to Science. Hence the author infers that in those regions much remains to be done. Twenty-two of the species are, it appears, common to European seas, but a large proportion of the remainder are peculiarly Australian.

Another paper of merit is a description, by H. J. Carter, F.R.S., of Foraminifera and Sponges dredged up by Captain W. H. Cawne Warren in the Gulf of Manaar and in Bass's Straits.

A number of papers are simply mentioned in the Contents or briefly noticed in the Proceedings, though many of them might be of superior merit and interest to those printed in full. We notice a memoir, by T. Higgin, F.L S., on "Fresh-Water Sponges." In it the author criticises the position taken by Prof. Huxley, P.R.S., that "the preservation of the individual and the continuance of the species are the final causes of the organisation" of the fresh-water sponge. This view Mr. Higgin pro-

nounces "the *merest* aassumption, which we are in no position whatever to prove"—or disprove?

The Rev. H. H. Higgins read a note on a collection of *Cirripeda* in the Free Public Museum, and which had been formed by the late Charles Darwin.

Mr. F. P. Mascart read a note on "A Branch in the Pedigree of the Genus *Nassa*, illustrating the Affinities of forty-eight named Forms with *Nassa hirta*."

The Rev. T. P. Kirkman, F.R.S., gave a short—and doubtless singular—reply to Mr. Herbert Spencer's critique on his "Philosophy without Assumptions," so called.

Mr. J. W. Thompson, B.A., read an important memoir on the recent subsidence of land in Northwich.

A communication by one of the corresponding members, Mr. E. D. Jones, C.E., of Sao Paulo, on the mode of feeding of a Brazilian *Mantis*, is very interesting.

Mr. Guthrie read a paper on "Spencer's Physical System as applied to Biology." We insert the Synopsis, all that is here given:—

"Part I. Reply to Mr. Spencer:—General estimate of the effect and value of Mr. Spencer's work.

"Part II. The Primary Facts:—The indestructibility of matter; the continuity of motion; the resistance of force; the ultimate absolute, the final meeting-place of all philophies.

"Part III. The Actual Process examined in order to ascertain the ruling and actual principle of physical change:—The constituents of the nebula—the concomitancy of the concentration of matter and the dissipation of motion disputed; is the universal process limited or unlimited? equilibration the ruling cause of change; equilibrium prevents change; the continuity of motion disputed.

"Part IV. Feeling and Consciousness excluded as Factors in Organisms:—The double-aspect theory.

"Part V. The Biological Explanations:—Organic matter; growth; development; function, waste, and repair; adaptation; the definition of life; the theory of the moving equilibrium; its application to life disputed; genesis unexplainable; on indirect equilibration, not equilibration at all; on the need for the continuation of species; conclusion."

(We have also received the volume for the year 1881-82, but owing to a great pressure of matter we are obliged to defer noticing it until the next month.)

On the Discovery of the Periodic Law, and on Relations among the Atomic Weights. By JOHN A. R. NEWLANDS, F.C.S., &c. London: E. and F. N. Spon.

WE have repeatedly felt it our duty to join in attempts for vindicating the claims of discoverers who have been overlooked. Thus we have persistently asserted the right of Dr. G. Walker to be regarded as the father of Sanitary Reform. In like manner we must now join in recognising Mr. Newlands as the originator of what is now known as the "periodic law." We were unpleasantly surprised, not long ago, when medals were awarded to MM. Mendelejeff and Lothar Meyer, to find that the claims of Mr. Newlands were treated, it would seem, with the "conspiracy of silence." Yet the case lies, it would seem, in a nut-shell. Mr. Newlands's priority is beyond all dispute. As early as 1864 he gave, in the "Chemical News," a list of all the elements then known in the order of their atomic weights, no similar table having ever before been published. In another accompanying table he gave the more important elements arranged horizontally in the order of their atomic weights, with blanks corresponding to some of the missing members of various groups. "In the trivalent group, beginning with boron, there was a blank next below zinc, since filled by gallium, and another blank immediately below cadmium, since filled by indium." In the group containing carbon, silicon, titanium, and tin, it was pointed out that an element of the atomic weight 73 was wanting. This is the very same missing element which M. Mendelejeff subsequently foretold under the provisional name of eka-silicium.

Thus the discovery for which the Russian chemist has been so much applauded—the prediction of an element as yet unseen, with its approximate atomic weight and its place with relation to other elements—was made and published by Mr. Newlands, at least four years before him.

We do not for a moment suppose that Mendelejeff obtained the fundamental idea of his "periodic law" from reading the communications of Mr. Newlands to the "Chemical News." On the other hand, it seems to us a strong confirmation of the value of this arrangement that it should thus have independently suggested itself to two different minds. Yet certainly Mr. Newlands, as the earlier discoverer and revealer, merits no less honour.

To proceed: in the "Chemical News" of August 20th, 1864, Mr. Newlands announced the existence of a simple relation among the elements when arranged in the natural order of their atomic weights, so that the eighth element, reckoning from any given one, was a kind of repetition of the first. Again, in the "Chemical News" for August 18th and 25th of the same year, he published a complete horizontal arrangement of the elements

in the order of their atomic weights. The relation existing between them he named the "law of octaves." This is merely another name for the periodic law of M. Mendelejeff!

Whoever will take the trouble to read this book, and especially to compare it with the author's original communications to the "Chemical News," will, we think, come to the conclusion that the claims of Mr. Newlands are strictly true, and will admit that he must rank as the first discoverer of the Periodic Law.

Geological and Natural-History Survey of Canada. By ALFRED R. C. SELWYN, F.R.S., Director. Report of Progress for 1880, 1881, and 1882. Montreal: Dawson Brothers.

THIS report—or perhaps we may rather say the reader—labours under a serious disadvantage. It is not paged through from beginning to end, but in each of its sections the paging begins afresh.

We learn that in the Museum there are now 3000 species of shells, out of a total exceeding 6000, duly arranged and labelled. A collection of Jurassic fossils, representing 598 species, has also been lately acquired.

The coals and lignites of the Bow and Belly River district have been examined with very satisfactory results. Workable coal-seams occur at several distinct stages, and extend over large areas of country. Some of the beds are of such quality as to be suitable for distant transport, and it is said that the railways of the North-west must depend principally upon this region for their supply of fuel. The deposits of the district completely bridge over the gap commonly supposed to exist between coal and lignite. The lignites are much superior to most of the lignites and brown coal which are successfully utilised in Europe.

There is an interesting report, by J. Macoun, F.L.S., Botanist to the Survey, on the plants collected by Dr. Bell along the Michepoten River and the southern part of the valley of Moose River, in July, August, and September, 1881. The character of this flora resembles that of Central Ontario.

Dr. John Leconte—we regret having to add *the late*—gives a report on the Coleoptera collected in the Lake Superior district and in the North-West territories. It is curious that the little dung-beetle, *Aphodius fimetarius*, so common in Europe, crossed the Atlantic as far back as 1835, and is now extending through the United States and the Dominion.

Among the minerals found is Samarskite, not hitherto met with in Canada, but which has now been discovered just beyond

the north-western limits of the township of Brassard, in Berthier County. The cerium oxides amount to 4·78 per cent.

The report is illustrated with a number of geological diagrams and plates showing the characteristic features of the country, and accompanied with maps showing the basin of the Moose River, the Lake of the Woods, and five districts of New Brunswick.

Papers and Proceedings and Report of the Royal Society of Tasmania, for 1881. Hobart Town: Mercury Office.

THE Proceedings of this Society comprise, among other things, records of meteorological and organic phenomena as observed in different parts of the island.

We see that the jargonelle pear and the More Park apricot are ripe January 12th to 14th, the greengage plum February 18th, and that the leaves of the ash and oak begin to fall in the last week of March. Mention is made of a proposal to introduce "many English birds" into the colony—a project of very questionable utility.

The first snowdrop seen in flower in the Botanical Gardens was on July 9th, and the almond tree blossomed on the 31st of the same month.

Among the papers read before the Society we may mention Notes on the Estuary of the Derwent, by R. M. Johnston, in which it is shown that this locality was during the Tertiary Epoch occupied by a fresh-water lake. This paper includes a description of the general appearance of the country at that date in accordance with palæontological researches.

Mr. C. E. Beddome contributes a description of two new marine shells dredged up near Three Hut Point.

Baron Mueller makes suggestions for an extended elucidation of the plants of Tasmania, and calls particular attention to Mosses, Lichens, Algæ, and Fungi.

Mr. Crouch suggests the improvement of the "Queen's Domain," the Colonial Park.

Another memoir by Baron Mueller describes the Flora of King's Island, situate about half-way between Tasmania and the Australian mainland, and displaying some interesting features.

The Mason College Magazine. Vol. II., No. 1. February, 1884. Birmingham: Cornish Bros.

THIS issue shows no falling off in the quality of its contents. Foremost stands an article on "Schiller as a Philosophic Poet," recalling to our mind strange memories of the past. Will man never be able to unsing the lamentation of the "Gods of Greece," by harmonising the poetic and the scientific Welt-anschanung? Certain ideas lately launched among us make us hope that this may yet be the case.

"Natural Selection and Degeneration" is a most suggestive paper. We read, some little time ago, a medical critique on certain portraits of modern female beauty, but all to the eye of the physician wearing the stamp of scrofula or of phthisis. Much of this, among the middle and the working classes, and the *parvenus*, who are fast elbowing the territorial aristocracy from their seats, is the outcome of our industrial organisation.

In an essay on Swedenborg, the scientific merit commonly ascribed to this mystic is denied. We are naturally sceptical concerning visions which reveal the assumed features of the known planets, but ignore those not yet discovered.

A paper on the relations between plants and animals shows no small ability.

We were not aware that political subjects are discussed at the meetings of the "Union"—not merely questions of what may be called political philosophy, but concerning the details of party warfare. Fortunately we were not compelled to read the debate in question, or we might have fared little better than the unfortunate masters of arts of the Sorbonne, when they encountered the "Borbonesa tart" concocted by Panurge. Might we presume to call the attention of the students to a passage which we quoted in our October issue (1882, p. 625) from the American "Popular Science Monthly"?

The Naturalists' World. Vol. I., Nos. 1, 2, and 3. London: W. Swan Sonnenschein and Co. Manchester: J. Heywood.

THE number of scientific periodicals has strikingly increased during the last few years. We can only hope that the demand is growing in at least an equal proportion; otherwise some of them can flourish—as indeed they seem to do—only by the introduction of irrelevant, if not illegitimate, features.

The little journal before us promises well, and may prove useful in winning over new votaries for Natural History if it is only conducted in a purely scientific spirit. Some of the matter given is exceedingly interesting. We notice especially the experience of Mr. F. W. Halfpenny concerning the virulence of the bite of the common viper. This snake has of late years greatly increased in Epping Forest, and in various parts of Hertfordshire, &c. This increase is, we think, due to the growing rarity of its only efficient enemy, the hedgehog. This useful little animal is hunted down by the gamekeepers on the charge of destroying the eggs of the pheasant and partridge, and often too falls a prey to the Gipsies. In consequence the viper multiplies unchecked. We do not in the least think Mr. Halfpenny's account of his sufferings too strongly coloured. We have personally met with fatal cases of the bite of this species in Hungary, Austria, &c. In Southern France, especially in the Gironde, the deaths among persons bitten are about 20 per cent. A few years ago a young man, whilst on a pedestrian excursion in Surrey, was bitten on the ankle whilst ascending Leith Hill, and died the next day in spite of prompt medical assistance. Whether their bite is more deadly in March and April than in the summer we are not prepared to say with certainty, but they are assuredly more vicious, perhaps because it is their annual season of sexual excitement. Mr. Halfpenny's description of the viper is correct as regards the female, but the ground colour of the male is of a grey, lighter or darker in different localities, and with the same black pattern.

Mr. George Hurst discusses the "Language of Animals." He says, however, little that is of importance, and introduces at the end an error. It is not true that among wild animals the destruction of life is always "accomplished with the least suffering." Bears, wolves, &c., eat their victims by piecemeal, not waiting for life to be extinct. The final remark about "the vile and fallacious excuse of scientific observation" is almost worthy of the *Zoophilist* or the *Police News*.

But for this effusion we could say that we have read the "Naturalists' World" with unmixed pleasure.

Geological Survey of Alabama. Report for the Years 1881 and 1882, embracing an Account of the Agricultural Features of the State. By E. A. Smith, Ph.D., State Geologist. Montgomery: W. D. Brown and Co.

This Report is exceedingly wide and thorough-going in its character, and though drawn up, of course, with especial reference

to the geological features and general local circumstances of the State of Alabama, it may be profitably studied by all interested in the future of Agriculture in any part of the world.

The author has prepared himself for his task by a careful study both of the natural phenomena of the district and of all the more important works in which agricultural chemistry is expounded. He begins with a general discussion of the composition, mode of formation, and properties of soils, and of the changes produced by cultivation. After treating very fully and carefully of the soil in its chemical and geological relations, of the conversion of rock into soil, and of the mechanical action of water and other denuding agencies in removing the waste produced by weathering, he goes on to consider the soil in its relations to vegetation. Among the organic agencies concerned in the production of soils the action of earth-worms is not forgotten. The views of Darwin have, it appears, been confirmed by practical men in Alabama, as elsewhere. We are told that "it has not escaped the observation of many farmers in this State that when a mass of sand has been washed down over a fertile bottom, it will, in a few years, again be covered by a layer of vegetable mould which earth-worms have, in the manner indicated, brought up from below and spread over it."

Passing on to the soil in its relations to animal life, Dr. Smith gives emphatic prominence to certain considerations too generally neglected. He shows that wherever plants alone are concerned there is a full restitution of plant-food to the soil. Its fertility, indeed, is not merely maintained, but enhanced, "since by the constant action of the weather, aided by the acids, &c., produced by the decay of one generation of plants, the inert constituents of the soil are gradually turned into an available form, and thus placed at the service of another generation."

Animals, however, disturb this equilibrium to some extent, and by the intervention of man the natural provisions for maintaining the fertility of the soil are further compromised. Not merely is a portion of vegetable matter removed year by year in the form of the crops, but by the destruction of the forests "the inequalities of the rainfall are very much exaggerated, heavy rains alternate with protracted drought; the soil, deprived of its protecting coat of vegetation, is exposed to all the destructive action of the rains, by which it is loosened and in a great measure carried away to be deposited again in the valleys; and the hill-sides, as well as the gentle slopes, are disfigured and often rendered unfit for cultivation by the cutting of gullies and ravines. With loose, loamy soils, such as characterise the greater part of the State of Alabama, the destruction of lands from this cause probably far exceeds their exhaustion by the improvident systems of culture usually followed."

We may add that this process of denudation, by which the soils are carried away into the valleys, and even into the river-

beds and sea, is in many districts accelerated by the "action of burrowing animals." We have often noticed that in slopes infested by rabbits, their holes seem to give the rain a special point of attack.

The following remark is true and sad:—"To the traveller through the Southern States, the pictures presented so often around the older villages and towns, of red clay hills, gashed and scored by unsightly gullies, are all too familiar."

The very same process has been carried on for a much longer time in all the countries of the Mediterranean Basin. It has been taken up in Central Europe, and in all European Colonies —British, French, Spanish, or Dutch. In short, desolation follows wherever the forests have been generally removed, whether by war, by the action of goats and camels, by fires, or by human greed. An American observer has wisely remarked, not long ago, that if one-fourth of a country is allowed to remain covered with trees and bushes, the remaining three-fourths will yield more food for man than would the whole if denuded.

As regards the exhaustion of soils, the author quotes from Mayer a very instructive remark explanatory of the fact that phosphoric acid must be present in the soil in much larger quantities than is actually needed for the present crop. The phosphates in the soil are insoluble, and must have come into direct contact with the capillary fibres of the roots before they can be assimilated. But as only a limited number of such particles can come into actual contact with the roots, only a small proportion of the phosphate present can be assimilated during one season.

Dr. Smith gives particular prominence to potash, nitrogen, and phosphoric acid as the three elements of plant-food most likely to be exhausted. As regards lime, to which M. Ville assigns an almost equal rank, our author holds that when added it serves not so much as plant-food as to produce changes in the other ingredients of the soil which render them more easy of assimilation.

The author's explanation of the manurial effects of gypsum is that it replaces the bases, especially potash, absorbed by the plants. He notices also the surmise of Heiden, that by a concentration of the soil-fluids it diminishes the transpiration of moisture through the leaves of plants, so that a dressing with gypsum may enable a crop better to resist the action of drought. He admits, however, that no theory as yet put forward fully explains the beneficial action of gypsum on leguminous plants and its uselessness for cereals.

We regret that we cannot further pursue our examination of this work, which must be recognised as possessing no mere ordinary degree of merit.

Journal and Proceedings of the Royal Society of New South Wales, 1882. Vol. XVI. Edited by J. A. LIVERSIDGE, F.R.S., Professor of Chemistry and Mineralogy in the University of Sydney. Sydney: Richards. London: Trübner and Co.

THIS number, though somewhat late in making its appearance, contains much important matter.

The President of the Society, H. C. Russell, F.R.A.S., the Government Astronomer, in his Anniversary Address, discusses the notion of producing rain artificially. This question does not excite much attention in England, since in nine seasons out of ten we have too much rain,—if not for the entire year, yet just in the months when every drop is a nuisance. But in South Africa and Australia the power of causing rain to fall at will would redeem vast tracts of country from barrenness, and save thousands of persons from severe losses. Mr. Russell has, therefore, carefully collected evidence on the possibility of rain-making. A vague notion prevails in several countries that fires, explosions, great battles, &c., are often followed by rain. Curiously enough some observers ascribe to the discharge of cannon the very opposite effect—the dissipation of storms! Mr. Russell does not seem disposed to deny that when the atmosphere is in the condition called unstable equilibrium, when a cold current overlies a warm one, violent concussions and columns of hot gases ascending, might determine rain; but in the dry years in Australia the equilibrium of the atmosphere is exceptionally stable.

Mr. Liversidge contributes a paper on the Deniliquin meteorite of 1872. This stone is of the great weight of 145 lbs., and belongs to the class of siderolites—mixtures of silicates with metallic nickeliferous iron. Copper, chrome, cobalt, manganese, and aluminium are present, but tin is absent.

The Bingera meteorite, described in the next paper, contains the same metals with the addition of tin, but apparently no manganese. It is interesting to note that these meteorites have been examined spectroscopically. The question has been raised whether such examination might not possibly lead to the discovery of certain of the rarer metals, or even of elements not yet recognised in our earth. The result, however, in these cases must be pronounced negative. Prof. Liversidge is still engaged with an examination of the Bingera meteorite, with especial reference to occluded gases.

Mr. Liversidge makes further communications on the chemical composition of certain rocks from New South Wales, New Britain, and New Ireland.

The Rev. J. E. Tenison-Woods describes at some length the Hawkesbury sandstone formation. He finds no evidence of glaciation, but notices traces of volcanic outbursts on a gigantic

scale. The flora buried beneath the volcanic ash appears totally different from that of modern Australia.

Mr. Russell communicates a paper on "Tropical Rains," illustrated with six maps. The heaviest rain on record in the Colony was in 1860, when downfall began at 4 p.m., and by 3 a.m. the Shoalhaven River had risen 100 feet!

The Rev. J. E. Tenison-Woods describes some mesozoïc fossils from the Palmer River, Queensland.

Mr. James Manning, in "Notes on the Aborigines," maintains that the blacks have a general belief in a Deity, all knowledge of whom is carefully concealed from the women and children.

The Aborigines form the further subject of discussion in a paper by J. Fraser, B.A.

We regret that Zoology in all its branches seems to be entirely overlooked by the Royal Society,—a fact the more serious in a country where so much work remains to be done.

Experimental Chemistry for Junior Students. By J. Emerson Reynolds, M.D., F.R.S., V.-P.C.S., Professor of Chemistry in the University of Dublin. Part III. Metals and Allied Bodies; with an Analytical Appendix. London: Longmans and Co.

Rarely do we open an elementary treatise on Chemistry without regret. The present volume forms, we are happy to say, one of the rare exceptions. It contains not a word of reference to any examination. No "syllabus,"—or "syllabub" as we heard it called by a rustic sage,—whether new or old, is here held up as the object to be held in remembrance by the learner. Dr. Reynolds rationally seeks "to place the student to some extent in the position of an independent investigator of chemical phenomena." He is to be led "to recognise the natural affinities of the elements, as well as their distinctive characters." Such an exception from the ordinary run of manuals, which aim rather at qualifying the student to pass some examination than to give him a living and fruitful insight into the science, is truly refreshing. Let us hope that it is an omen of better things for the future,—of a reaction against that miserable examinationism which earns for us the title of the "Chinese of Europe."

Our Corner. A Monthly Magazine of Fiction, Poetry, Politics, Science, Art, Literature. Vol. III., No. 3, March 1st, 1884.

This Journal, though of heterodox repute, shows no lack of ability. With its literature, and above all its politics, we can have no concern. But we find here two scientific articles of undeniable merit; to wit, the "Microscopic Examination of Rocks," by W. Mawer, and "Insects and Flowers," by Dr. E. B. Aveling. The latter writer seems to us to impart here a larger amount of sound scientific truth than is generally offered by a certain showy and admired author who treats largely on kindred subjects. Perhaps Dr. Aveling is thinking more of his subject and less of himself than do some of his contemporaries. We are particularly gratified at finding prominent notice given to the fact—often overlooked—that between the entomophilous and the anemophilous plants there is no rigid line of demarcation. We can strongly recommend this essay to students, of whatever age.

In passing we may notice the biography of Bruno, which is introduced at the end of the number. In it the outlines of his life are filled in without being distorted. It is strange to us that no one has yet selected the hero-sage of Nola as the subject of a philosophical novel.

To show the undiscriminating manner in which some publishers send out books for review, we mention that we have received from Mr. J. Morris of Chicago, a treatise entitled "Mr. H. Irving and Miss Ellen Terry in America"!—a matter as much outside our cognizance as are, *e.g.*, the proceedings of the Salvation Army.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HYLO-IDEALISM.

PERMIT me to thank you for your admirable review of Captain McTaggart's very ingenious "Examination of Hylo-Idealism," and at the same time to offer a few remarks which may tend further to clarify the subject. The last sentence which you quote may possibly becloud, for uninitiated readers, the strictly Monistic character of the thesis maintained by Dr. Lewins. Captain McTaggart states that "Matter is affected by spirit (force), spirit by matter." This seems at first sight to re-admit Dualism; but from other passages we gather that the mysterious "Spirit" is merely the noumenon or proplasm of physical and psychical phenomena. Now it is surely far simpler and better to speak of this proplasm as "Matter," and thus to avoid the very equivocal term "Spirit," which is irrevocably committed to Dualistic associations, and really is itself material, as it means nothing but "breath" or "wind." The word "Matter," on the other hand, being identical with "mater," the mother or producer, is especially applicable to the *fons et origo* of the phenomenal world.

The sentence "What is matter, or what is spirit, we cannot know, and what their point of contact is we may not even imagine," when taken in conjunction with the statement that spirit is "an unknown x underlying force and matter," can scarcely fail to suggest reminiscences of the Athanasian Creed, with its "three incomprehensibles," which yet, in the end, are not Three, but *One* incomprehensible.

C. A.

THE DETECTION OF BACTERIA AND THE SEWAGE QUESTION.

IT might have saved Dr. P. Frankland some trouble if, in his alarmist paper read before the Society of Arts on the 13th ult., he had remembered that bacteria, &c., are precipitated from

water by the addition of a few drops of a solution of aluminium sulphate. On straining off and re-dissolving the precipitate the bacteria are found. The success of this process, known as Brautlecht's method, shows that disease-germs need not be feared in the effluent water of sewage which has been treated with sulphate of alumina. Had this fact, and the action of alum in rendering foul waters harmless,—well known in China, Cochin China, &c.,—been considered, the public might have been spared the *rechauffée* of the Report of the Rivers' Pollution Commissioners to which they were treated by Dr. Frankland.

ARGUS.

ERRATUM.—March No., heading of article on "Vaccination," *for* GILEBS *read* GIBBS.

NOTES.

According to the "Courrier International" there exists at Sonora a pyramid measuring at its base 4350 feet, and rising to the height of 7550 (? 755) feet. Hence its size is about double that of Cheops.

Mr. Harold Whiting ("Science-Bulletin") proposes the following law connecting the physical constants:—"The product of the latent heat, molecular weight, and coefficient of expansion = 8·4 for liquids at 0° C. expanding by ordinary law. The product of the mechanical equivalent of the latent heat and the density is 1·2 times the product of the coefficient of expansion and resilience, and the absolute temperature."

It appears that the so-called "National Park" of the United States requires attention to guard it against the attacks of speculators.

From a recent decision it appears to be perfectly legal to pollute and poison underground waters, springs, &c., by running into them sewage, &c.

It appears that in the years 1831 and 1876-77 atmospheric phenomena, very similar to those observed in November and December last, were noticed and recorded.

On January 14th a sudden retreat of the sea, followed by three waves which raised it for a short time to 1·5 metre above its ordinary level, occurred at Monte Video.

According to M. G. Calmels the poisonous secretion of the toad contains a small quantity of methyl carbylamine and of isocyanacetic acid, to which it owes its poisonous properties. A similar acid exists in the poison of *Triton cristatus*, *Salamandra maculata*, and of the scorpion.

We regret to hear that the Dublin Zoological Society is in danger of coming to an end from lack of funds. The case seems the more hopeless as unworthy means of increasing the Society's income have already been resorted to. The returns of a dog-show (!) held last year in the Society's garden were £153.

M. P. Gibier ("Comptes Rendus") finds that rabies can be communicated to birds, which, however, recover spontaneously. Mammals inoculated from such birds die with the ordinary symptoms of rabies. M. Pasteur questions the immunity of birds.

MM. Moncorvo and Silva Araujo have succeeded in curing elephantiasis by the application of electricity.

Dr. J. Foster, in a paper read before the Sheffield Medico-Chirurgical Society, advances the questionable opinion that "some of the greatest literary productions have been the work of men between 50 and 70. Living public men in every department of literature, science, and art may be cited as proof."

Mr. G. Dimmock ("Science") has found a redeeming feature in the character of the common earwig. It is an eager devourer of fleas, and may therefore claim toleration in bed-rooms, though not in gardens.

At the coming Montreal Meeting of the British Association the following subjects are selected for special discussion in Section A (Mathematical and Physical Science):—

1. On Friday, August 29.—The seat of the electromotive forces in the voltaic cells.
2. On Monday, September 1.—The connexion of sun-spots with terrestrial phenomena.

The names of those who propose to read papers, or are willing to take part in the oral discussions, should be sent not later than June 1, 1884, to *The Secretaries of Section A, British Association, 22, Albemarle Street, London, W.* No paper should in reading occupy more than fifteen minutes, and no speech more than ten minutes.

During a recent technical trial a learned judge observed that he had a great respect for professional witnesses, but none for *witnesses by profession.*

An international ornithological conference is to take place, on the 16th of this month, at Vienna.

A biological institute is about to be organised at Philadelphia.

At a recent meeting of the Entomological Society a paper was read on the decrease of butterflies in the district of Huddersfield during the last twenty years. Several gentlemen referred to a similar decrease in other parts of England, common species having become scarce, and scarce ones disappearing entirely.

According to M. E. Juny violet light is favourable to the development of the eggs of various animals, whilst green and red lights seem to have an injurious, or at least a retarding, influence.

It is a characteristic tendency of the anti-scientific mind to refer physical phenomena to moral causes. See Mr. Ruskin's remarks in "Fors Clavigera" on recent cloudy seasons.

M. G. Karsten remarks that after the great eruption of Skapter Jokul, in Iceland, in the spring of 1783, atmospheric phenomena similar to those of the past winter were observed in Europe, northern Africa, and eastern Asia.

"Les Mondes" informs us that aluminium has been found an excellent remedy against phthisis. (But not, surely, in the metallic state?)

An attempt is being made to introduce the turtle in the seas of Provence, Algeria, and Corsica. Plots are being arranged where these creatures may deposit their eggs in safety.

According to Mr. W. H. Harrington ("Science") the Coleopterous fauna of the neighbourhood of Ottawa, Canada, includes 1050 species. It is poor in Carabidæ and Dytiscidæ, but relatively rich in Buprestidæ, Elateridæ, and Cerambycidæ.

During the last three years the cases of hydrophobia in the Department of the Seine have been respectively 17, 11, and 6.

According to "Les Mondes," in the districts of the Opera and the Madeleine, the Edison Company are distributing electricity from house to house, and supplying the inhabitants with power and light almost gratis. The writer adds "Mon Dieu! que l'espérance est une belle chose!"

A company is being formed in America for constructing a ship-railway across the isthmus at Tehuantepec.

Says M. Valette—"Everyone knows that at the Academy the power to bind and to loose is vested in the Perpetual Secretary alone."

From an official report, quoted in the "Pall Mall Gazette," we learn that of the 81,000 masters and mistresses in the public schools of France, 48,000 receive salaries below £40 yearly!

We remark that the National Museum of the United States, though provided with distinct Curators for the Departments of Conchology, Ornithology, Ichthyology, Herpetology, for Marine Invertebrates, and for Mammalia, has none for Entomology.

It appears that the antiseptic properties of carbonic acid were observed and recorded by a Dr. Macbride prior to Hermbstädt. Macbride's experiments are mentioned in the "Essai sur differentes Especes d'Air," by Sigaud de la Fond, published in Paris, in 1769. Hermbstädt's work did not appear until 1791.

M. Pasteur ("Comptes Rendus") announces that the less of the virus of rabies is introduced into any animal, the longer is the stage of incubation, and the more furious is the type of disease which follows. But if dilution is carried beyond a certain limit the inoculation takes no effect.

Mr. Hugh Browne points out that the Sutlej descends 12,000 feet in 180 miles, or at the rate of 666 feet per mile, being probably the swiftest great river in the world.

At the Annual Meeting of the Royal Society of New South Wales, in 1883, papers were read on the Geology of the Hawkesbury Sandstone, by Rev. J. E. Tenison-Woods; on Tropical Rains, by H. C. Russell, F.R.A.S.; on the Orbit of the late Comet, by G. Butterfield; on a Method of determining the True South, by J. S. Chaud; on the Progress of New South Wales, by Chr. Rolleston; on Marine Fossils of the Coal Formation of New South Wales, by Rev. J. E. Tenison-Woods; on Mesozoic Fossils from the Palmer River, by J. C. Tenison-Woods; on French Geographical Societies, by E. M. de la Mesler; on Aborigines of Australia, by James Manning; on the Ashes of some Epiphtic Ferns, by W. A. Dixon; and on a Fossil Plant Formation, in Central Queensland, by Rev. J. E. Tenison-Woods. M. Louis Pasteur was elected an Honorary Member, *vice* Charles Darwin, deceased; and Dr. Ottocar Feistmantel a Corresponding Member.

M. Zenger has constructed a direct-vision spectroscope for the observation of the ultra-violet rays. It consists of a new combination of prisms of quartz and calcareous spar.

It is said that during the tempest of January 26th telegraphic communication between Paris and the provinces would have been substantially cut off had it not been for the underground wires.

During the earlier part of 1883 the atmosphere at Reunion was so pure that the planet Venus could easily be distinguished with the naked eye during the whole of the day.

M. G. Le Grant de Tromelin ascribes the production of atmospheric electricity, in a great measure, to the friction of the air against the surface of the land and of the sea.

A writer in "Cosmos les Mondes" remarks that Sirius, which to us appears of a brilliant white, is described by Horace as *rubeus* and by Cicero as *rutilus*.

According to the "Medical Press and Circular" the University of Oxford, by a decree of Convocation passed on the 4th ult., has decided to engage a table at the Zoological Station of Villefranche, for the use of students of the University. The Bestiarians made a counter demonstration, but did not venture to go to a division. (It is instructive to compare the watchfulness and energy of the Bestiarians with the "masterly inactivity" of the Society for the Promotion of Medicine by Research.)

It is understood that a Bill for the incorporation of the Institute of Chemistry is to be introduced into Parliament during this

Session. Without great care this will be made an occasion for increasing the power and influence of the Science and Art Department.

According to P. Shiemeny (" American Naturalist ") the supposed olfactory mucous gland in insects secretes saliva.

With a view to the complete study of the migration of birds in the Nearctic Region the whole of the United States and British North America have been mapped out into thirteen districts, in each of which is a Superintendent whose duty it is to collect information from observers and transmit it to Mr. C. Hart Merriam, Chairman of Committee on Migration, Locust Grove, Lewis County, New York. Birds are classed in five categories, —permanent residents, winter visitants, transient (spring and autumn) visitants, summer residents, and stragglers. Ornithological movements are to be noted in connection with meteorological phenomena and with the changes in the vegetable world.

According to T. R. Peale (" American Naturalist ") the inhabitants of Fanna Loa eat their food raw, and appeared terrified at fire, even on so small a scale as a lighted cigar. No traces of charcoal, ashes, or other signs of cooking, were found near their houses. Hence the command over fire and the use of cooked food can no longer be put forward as general characteristics distinguishing man from the lower animals.

We have to express our pleasure at learning that Prof. Bryce is about to introduce a Bill into Parliament for throwing open the mountains, moors, &c., of the Highlands, to geologists, botanists, entomologists, artists, &c., on the simple condition that they shall not be accompanied by dogs, and shall do no damage. This Bill deserves the warmest support of all lovers of Nature.

Dr. F. V. Hayden (" Science ") warns all whom it may concern against a swindler who introduces himself to scientific men as a colleague, professes to be preparing memoirs on some special subjects, and steals books and specimens, or, if this is impracticable, borrows them and never returns them. He has robbed several museums, libraries, &c. Should he visit Europe we recommend our friends to be on their guard.

According to Prof. A. Graham Bell congenital deafness and epilepsy, instead of being rarer, are more common among the Negro and Negroid population of the United States than among the Aryans.

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